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FIELD AND HOSPITAL SERVICES FOR CIVILIAN DEFENSE

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THE Medical Division of the Office of Civilian Defense has been at work since June 1941 developing plans to provide medical care for civilians injured in the war. Little has been seen in the public prints about the steady, grinding work that has been going on in the Washington office, in our regional offices and in the hospitals, health departments and medical organizations of the country as the Emergency Medical Service is built into a strong, efficient structure.

When we began our work early in the summer of 1941 we not only had to plan a new medical activity, but we had to move against indifference and even opposition. Events have proved that we started none too soon. Until Pearl Harbor only some of the coastal cities were sufficiently concerned to proceed with organization in accordance with the plans which we had formulated. Since that fateful Sunday, organization has gone forward rapidly in every part of the country, even in cities that had previously felt they were immune from attack. There still remain some localities even in our seaboard areas, in which no need is felt for Emergency Medical Service plans.

We have had the inestimable advantage of being able to follow the British experience. We sent representatives to England to study at first hand and, most helpful of all, we have had British experts at our elbow through these crucial months of development. Their guiding hands have enabled us to avoid many errors they discovered

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only by grievous experience. Thus our path has not been wholly uncharted nor guided only by trial and error.

Our plan for Emergency Medical Service necessarily differs in its structure from that of the British. The diversity of our state and local governments dictated some variations. Moreover, the hazards to which we shall be exposed are likely to be different from those which the British have faced.

The Emergency Medical Service is founded on the great hospital system of the United States. Careful thought will make it evident that this plan is logical. It is true that the war is draining hospitals of both physicians and nurses; yet the field casualty service must be primarily centered about hospitals if it is to be effective.

In the early months of this program it was urged by many that emergency medical field units be organized among physicians and nurses not associated with hospital staffs. Let us consider what such an organization means in terms of operation. Physicians and nurses busy at their daily routine, in their offices and on their rounds of visiting patients, would have to be notified to report to Casualty Stations every time an air raid warning signal is given. The area alerted might extend from Cape Hatteras to Florida and several hundred miles into the interior. The raiders might be driven off by our interceptor air squadrons long before they reached our coastal cities. Yet hundreds of doctors, nurses and auxiliaries would have moved needlessly throughout this extensive area to places of assembly.

At each alerting of an area, which might occur repeatedly during a day or night, there would be a lamentable waste of time and effort. There would also be unnecessary movement through the streets at a time when traffic should be reduced to a minimum.

One of the most striking lessons that British advisers brought to us was an insistence that manpower should not be wasted by the dispatch of field units to a scene of disaster too soon or in too great numbers. Although it may look impressive to the public and to the representatives of the press to witness ambulances and other emergency vehicles dashing through the streets in peacetime, the situation is far grimmer when planes are dropping bombs in many places at once and no one knows how long the bombardment will continue. Field units organized in hospitals are where they can be found when they are needed, they can continue their normal work until authorities at the control center order them out to a specific incident where casualties have been reported.

If, however, bombing is prolonged or repeated, hospital units may be relieved by reserve units made up of physicians and nurses

of the community. These units should be related to hospitals and drilled regularly. Small hospitals that have no resident staffs should develop a plan under which one or more physicians are on call at stated times. Such physicians would not have to remain in the hospital, but should be ready to move when a warning is given.

To assure efficient movement of the protective services a highly centralized system of control has been devised. When the military aircraft warning service reports that enemy planes have been sighted, a confidential preliminary warning ("yellow" signal) is sent to the chiefs of all protective services, who must go immediately to the control center. The only medical person who receives this warning is the local chief of Emergency Medical Service. If the planes come nearer and it appears that a raid is imminent, the confidential "blue" message is sent. This is primarily a "lights" warning, intended to give opportunity to industrial plants, transportation companies, hospitals and other essential places to effect a blackout. Neither of these warnings is known to the public.

When it is certain that the enemy is about to unleash an attack, the red message is transmitted. Then the siren sounds to warn the public. The protective services go into action. Emergency medical field units based on hospitals still need not move. Teams are assembled, their equipment and transportation are made ready, but there is no movement of doctors and nurses until an air raid warden at the scene of disaster has reported to the control center. The warden describes the destruction briefly and estimates the number of casualties.

A thorough understanding of the nature of air raids will make plain the reason that we must depend on the hospitals for the primary field units. We recognize that hospitals cannot long spare members of their medical and nursing staffs and we have therefore recommended organization of reserve units among physicians and nurses not attached to hospitals. But we cannot mobilize all the doctors and nurses every time an area is "alerted." Alerting may recur several times a day. Incidents are utterly unpredictable in scope. Some may require medical service; others may involve warehouses or other uninhabited structures, what may seem at first to be a devastating attack may be followed two hours later by one much more severe. If it is known that trained field units exist in hospitals, there is no useless chasing about of doctors and nurses, with lost time and motion and eventually loss of discipline. In peacetime all the medical personnel of a community may race to the scene of a disaster without depriving the general population of essential services for any length of time. This type of war disaster

is different; it is imperative that we conserve manpower under centralized administration.

In the control center the local chief of Emergency Medical Service or his deputy acts as medical adjutant to the Commander of the Citizens' Defense Corps. The adjutant has in front of him all information on hospital beds, the number of field units available, the number of casualties each hospital can handle, the locations of casualty stations, the ambulances assigned to hospitals and the number of casualties directed to any particular hospital at a given time. The medical adjutant must be informed at frequent intervals, at least every two hours, of the casualties admitted to hospitals. As soon as any hospital approaches the limit of its capacity, it must notify the control center so that casualties may be diverted to another hospital. The British advise that the stream of casualties to a given hospital is stopped when the hospital is within twenty beds of its capacity. This margin should be provided to allow for casualties who will inevitably reach the hospital after the report has been made to the control center.

To keep the flow of casualties moving, the control center must have complete and accurate control of ambulances. Every vehicle, whether it is a hospital's own ambulance, a privately owned ambulance, a converted station wagon or a taxicab from a transport pool, must move only on specific orders from the control center. It must be remembered that these vehicles will be traveling in a complete blackout over streets that may be blocked with the wreckage of buildings and made perilous by bomb craters. In the early months before a control system was worked out in Britain, fleets of ambulances were sometimes lost for hours. Any person near an incident could call an ambulance. Before the situation was brought under control, it was necessary to order that all private telephones be cut off during a raid.

To facilitate control in large cities, district control centers have been established, with a main control center to coordinate them all. New York has seven such centers, Chicago six. Each district control center has a complete staff representing all the protection services. If one district is heavily bombed, it may need more ambulances, field units and hospital beds than are available within its own boundaries. The deputy commander in the district control center reports the needs to the main control center, which orders the necessary services from other districts under less pressure.

You as surgeons will be personally concerned with the handling of casualties in hospitals. Many persons, even physicians, do not yet realize the severity of air raid injuries. British and Spanish

experience has shown us that from 40 to 50 per cent of persons injured in bombing raids are killed outright or die soon after they are wounded. Most of those who survive are so severely injured that their lives depend on immediate care and quick transportation to hospitals.

The condition of casualties when they arrive at the hospital differs from that of peacetime accident victims in two important respects. The injured are covered from head to foot with thick grime, the dust and dirt raised by the blast, cement and plaster from falling buildings. The second striking feature is the frequency of grave crushing injuries and the frequent penetration of missiles, including bomb fragments and flying splinters of stone, wood and glass. Fragments of glass sometimes strike with such force that they cause wounds like those made by bullets and may even cause comminuted fractures by direct impact.

Even a fairly large hospital cannot care for more than about fifty such operative casualties in twenty-four hours. Even with two operating tables set up in each operating room so as to save anesthetists, nurses and other personnel, the hospital can take care of only about one and a half cases per hour per table per operating team.

It is apparent that communities bearing the brunt of enemy attack, with destruction of life and property, cannot also carry unaided the burden of the costs of medical care for its injured citizens. In anticipation of the emergency, the Federal government is prepared to assume a part of the cost of hospitalization of civilian casualties and other hospitalized persons who must be moved by reason of enemy action. Through the Federal Security Agency funds have been made available to pay hospitals at a specified per diem rate for the care of war casualties and hospital evacuees. This plan is to be administered by the Medical Division of the Office of Civilian Defense in cooperation with the U. S. Public Health Service.

Plans to designate "emergency base hospitals" in protected rural areas are also under way as a part of the hospital program under development. Mental hospitals in the country, homes for chronic and convalescent patients, specialized hospitals and various other types of institutions outside our large cities will be designated to receive patients from the hospitals in the danger zones. There may be several reasons for evacuating a front line hospital. Chronically ill patients, or those undergoing extended treatment, may well be moved to institutions in less exposed positions. A hospital in the line of attack may be so severely damaged as to become useless. Or an unexploded bomb may land so near a hospital that military

authorities must order the building evacuated. Still another possibility is that hospitals giving immediate care to war casualties may become crowded, and acutely ill patients as well as casualties may have to be removed to make room for the newly injured or the casualties which are anticipated.

Hospital officers have been appointed in some of the more exposed states to survey available facilities and carry out the work of relating casualty receiving hospitals to one or more emergency base hospitals. As many of the emergency base hospitals must be institutions which may not have professional staffs adequate for the care of the acutely ill, it will be necessary that physicians be available for this service. It is planned that the physicians, surgeons, specialists and dentists who are to staff the emergency base hospitals, will be derived from a "parent" hospital or group of hospitals of the locality. They will be organized into affiliated units in a manner similar to the organization of the Army General Hospital Units, and will be called to active service as needed, and for service in the localities in which they reside.

Under the new hospital program of the Medical Division and the Public Health Service, state chiefs of emergency medical service, state hospital officers and members of the affiliated units organized to staff the emergency base hospitals are to be appointed consultants or commissioned in the U. S. Public Health Service for the duration of the war and for six months thereafter. Members of the affiliated units will be commissioned in the inactive reserve and will be called to active duty only when necessary. It must be emphasized that all hospitals, voluntary or governmental, will continue to be administered by their local authorities, as at present.

Hospital beds and mattresses are in process of procurement for storage and distribution where needed. Necessarily such equipment must be restricted for the present to the most vulnerable areas.

A serious difficulty in the development of hospital service is the steady depletion of the supply of nurses. When the Medical Division began to function last July, nurses were already being drawn from hospitals to fill the needs of the armed forces and the mushroom communities that had grown up in the vicinity of defense industries. Knowing that there was no way of training nurses rapidly enough to make up for the steadily mounting losses, we had to find a way of conserving the trained nurse's time and effort so as to make her services available to more patients. In collaboration with the Red Cross and the national nursing organizations, we established the Volunteer Nurses' Aide Corps.

The curriculum of instruction, requiring two or three hours a day

five days a week for about seven weeks, was designed to provide trained and disciplined aides for the nurse. We know that this training is superficial. It is not intended that the aides should assume the technical duties of the nurse; they must do only the work they are competent to perform always under supervision of the graduate nurse. Many hospitals which have now had nurses' aides on duty for several months give them high praise. Unfortunately, too few women volunteered in the first few months of this program. We planned for the training of 100,000 and the number now on duty and in training is still only about 18,000. Surely if the need for this great service and the opportunity it affords to contribute to the war effort are adequately presented to our women of leisure, they will come forward in greater numbers. Although it was expected that only women with leisure could take the exacting course, many classes have been organized for business and professional women. After their own day's work is done, these women take their training in evening classes and after completing their training they continue to serve in the hospitals evenings, holidays and Sundays. When the great moment of need arrives, they will all serve in our casualty receiving hospitals, casualty stations and first aid posts.

Nurses' Aides will serve not only in the Casualty Receiving Hospitals, but also in the Emergency Medical Field Units. Nursing service will have to be provided in the Emergency Base Hospitals, and in this the aides may take an important part. Besides these emergency activities, the customary nursing duties of the community must go on. The work of public health nurses, visiting nurses and school nurses will be no less important than it is in peacetime. Here, too, the aides may give invaluable service. In many British first aid posts and even in some hospitals during emergencies there have been four nurses' aides to one trained nurse.

For several months the Medical Division has realized that cities exposed to attack did not have adequate blood and plasma reserves for the treatment of civilian casualties. From the tragedy of Pearl Harbor we learned that many lives were saved by plasma from a blood and plasma bank established by a private physician with his own funds. Several months before Pearl Harbor he became worried because there was no reserve of plasma in case of an emergency, and without assistance he started the bank that was the main source of plasma in the crucial hours following the Japanese attack.

We are now undertaking to assist 300 approved hospitals of 200 or more beds, in cities likely to suffer from enemy action, to establish blood and plasma banks and to accumulate a reserve of plasma. A technical director is now on duty in the Washington office and

several regional technical experts will be appointed to assist competent hospital laboratories in the establishment of these banks.

As a further protection we plan to encourage and assist certain laboratories to produce dried plasma so as to build up a reserve which can be held by the Medical Division and rushed to any stricken community whenever its own stores of liquid or frozen plasma are in danger of depletion. The Red Cross has agreed to collect blood for this purpose without interfering with its collecting service for the Army and Navy. For immediate protection the Red Cross has released small amounts of its supply of dried plasma to a few cities along the seacoast and in major industrial areas.

Recently Congress appropriated $100,000,000 to be spent for equipment to be used in the protection of civilian lives and property. Some of this fund will be spent for medical supplies and equipment. This equipment will consist of kits for medical teams, kits for Casualty Stations, stretchers, cots and first aid pouches.

A system of allocation of this property has been worked out by the Director of the Office of Civilian Defense with the advice of the Army and Navy. Certain communities have been designated as of first or second priority. First priority will be given to communities most exposed to enemy attack, or to key cities whose industries are necessary to the war effort and therefore in danger from injury through sabotage. After the first group of cities has been supplied, some equipment may be available for cities of the second priority.

In accordance with the President's wish that the Office of Civilian Defense utilize the facilities of other government departments wherever possible, all items of supplies and equipment will be purchased for the Office of Civilian Defense by the War Department. The Medical Department of the Army will integrate the purchases of the Office of Civilian Defense with its own purchasing plans. However, the purchase of civilian supplies and equipment will not be allowed to hinder the procurement of items necessary for the furtherance of the war effort.

Many of the supplies such as fire fighting equipment will be shipped directly from the manufacturer to the receiving community. Others, such as the kits for the medical teams, which are composed of dozens of small items, will have to be assembled. This will be done at five strategically situated warehouses, from which the final distribution will be effected.

The mayor, or other responsible officer, of each community to which protective equipment has been allocated must certify that his city needs and is unable to obtain the listed equipment. Further,

he must state that his city has the facilities for the proper care, use, protection, and maintenance of this equipment, and that it will be used only for the purpose intended and according to regulations laid down by the Director of the United State Office of Civilian Defense.

The Federal government will retain title to this equipment so that if necessary it may be removed from one community and transferred to another where it may be needed more urgently. In its purchasing program the Medical Division has attempted wherever possible to utilize Army, Navy, or other existing Federal specifications, so that the correlating of Office of Civilian Defense purchases with the Army's regular procurement program can be accomplished with the minimum of confusion.

These are some of the activities of the Medical Division of the Office of Civilian Defense. Other urgent problems are beginning to receive our attention. Difficult medical problems may require solution if it should become necessary to evacuate any considerable number of persons from large cities. A transport service must be organized to evacuate endangered or damaged hospitals. Plans must be made for mortuary service. A system of casualty reporting must be established. We are now at work on these problems while carrying forward the other phases of the medical program. Enemy attack will not find us unprepared.

CANCER OF THE BREAST

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CANCERS of the breast are not one entity but a group of neoplastic diseases, which differ not only in cause, pathology and rate of growth but also in response to treatment. Experimental research on animals and the careful consideration of clinical cases leave no doubt that these neoplasms may arise from or be produced by a wide variety of conditions, one or more of which may play its part in any particular growth. Heredity, estrogenic hormones, chronic infection and persistent irritation all play important parts in the production of tumors having a wide variation in malignancy, histology and response to therapy. These wide variations of characteristics make it necessary for us to examine carefully and individualize each case in order that the available therapeutic methods may be used to the best advantage. Only in this manner can we increase the number of patients cured and the years of life and comfort for those who are incurable.

The statistical data on this subject must be subjected to the closest possible analysis before conclusions can be drawn. Series of cases treated by surgery alone are compared to other series treated by radiation or a combination of radiation and surgery. The pathology, stage of advancement of the disease and many other important factors are frequently given no consideration. Recent series treated by skilled radiologists and having surgery performed by masters of technic are compared to series having operative treatment performed by diverse surgeons and diverse technics. Results in modern surgical series are also compared to results obtained by radiation and surgery when radiation was much less exact than it is at present. Conclusions based on such studies have produced a chaotic condition concerning the treatment of breast neoplasms. This condition should not exist and can be relieved by proper cooperation of pathologist, radiologist and surgeon.

No group or individual incapable of using both surgery and radiology, or biased in favor of one method is capable of treating cancer of the breast. Both surgeon and radiologist should carefully examine the patient before treatment is planned. The surgeon should constantly observe the progress of the case while radiation is being administered. The radiologist will profit by observing at the time of operation the extent and position of glandular involve-

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ment. A reasonable knowledge of pathology is indispensable to both surgeon and radiologist.

The factors which determine the number of cures in any series of cases of breast cancer are in order of their importance as follows:

1. Stage of development: All malignant tumors are at some time entirely localized and can be cured by simple removal.

2. Malignancy of the neoplasm and its rapidity of growth: A rapidly growing tumor is of higher malignancy and is usually much further advanced than appears clinically to be the case. In these cases glands are frequently involved although not palpable.

3. General condition of patient: Young women and women who are pregnant or lactating exhibit an increased risk.

Patients whose prognoses are favorable when these factors are considered will always comprise a majority of the cures in any series and the chief factor in higher numbers of cured cases in any given series is the presence of a greater percentage of these favorable cases. An unusual number of inflammatory or anaplastic carcinomas will ruin any statistics. A good pathologist by examination of tissue slides can tell you the fate of many of your patients.

The clinical stage of a breast neoplasm is determined by information gained by examining the patient and finding the presence or absence of glands, fixation, ulceration or metastases. Glands may be palpable and not malignant. Glands may be malignant and not palpable. Both conditions occur with almost equal frequency. Harrington found 32 per cent enlarged glands not cancerous and 29 per cent cancerous although not palpable. The presence of malignant glands which cannot be palpated may be assumed with accuracy in many cases. Elevation of the breast, additional fullness beneath pectoral muscles and below the clavicle, rapidity of growth and size of tumor all suggest that glands are involved although they are not actually palpable. By carefully considering the indirect evidence of glandular involvement a much more accurate preoperative classification can be made. The only accurate classification is of course the pathologic classification which is made after the tissue has been removed.

For the cure of cancer we have available surgery, roentgenotherapy and radium therapy. While using these the patient should not be forgotten. Liver extract, calcium and amytal during radiation therapy have proved extremely useful. Calcium may have a beneficial effect by direct action on the cancer cell metabolism. Treatment of other diseases which exist should not be neglected.

Cancer of the breast is uniquely adapted to radical surgery. The lymphatic drainage areas are accessible and a very widespread re-

moval of tissue may be accomplished with extremely low mortality rate. The particular technic adopted is of little importance if a wide removal of all available tissue is carried out. A small lesion is no justification for a small operation. No thought should be given to closure of the wound until the operation is completed. In the majority of cases if the operation is sufficiently wide the skin will cover. If it does not cover, grafts are easily cut and applied. Grafts are not proof of a wide operation. Skin closure can be prevented by failure to dissect adequately to each side of the incision as effectively as it can be prevented by the removal of large amounts of skin. All tissue that may harbor cancer cells should be removed whenever possible. No gamble should be taken with the patient's life. Very small tumors may have nonpalpable malignant glands.

The use of radium therapy as a major method has been reported in a series of cases treated by Keynes. He states, "This is purely a local treatment as is surgery." At present good surgery seems the better method. As an adjunct to surgery and roentgenotherapy, radium is valuable. The judicious distribution of radium needles at the time of operation is advisable in cases where higher involvement is found than was expected preoperatively. In carcinomas in the medial aspect of the breast invasion beneath the sternum and into the intercostal spaces may take place early. In these cases I insert radium needles beneath the sternum and into the intercostal muscles. I believe this is of some value.

The use of roentgenotherapy prior to and following surgery in operable cases is at present the most controversial point in the treatment of breast cancer. A compilation of a number of series of cases treated by x-ray alone, surgery alone and by combined methods has been made by Pack and Livingston who, after applying proper correction factors, find no appreciable advantage in combining x-ray with surgery. All corrective factors however have been applied against any apparent advantage derived from x-ray. The well established fact that a certain percentage of proven cases of breast cancer are found to have no malignancy postoperatively when x-ray has been used is entirely ignored. A certain percentage of cases, I believe are also removed from pathologic Stage 2 to pathologic Stage 1 thereby improving the prognosis for surgical cure.

Quimby and Adair reported 14 out of 117 patients with positive biopsies who after preoperative x-ray had no cancer found postoperatively. I among others have had such cases. If a correction for these factors is made in favor of cases given preoperative therapy, there is a small percentage of increased cures.

The advantage in the use of preoperative therapy is only seen in cases actually or assumed to be in Stage 2 and chiefly in younger patients with tumors of rapid growth. This opinion was arrived at by a careful analysis of available statistics and a careful detailed study of all breast malignancies seen in the City County Hospital Clinic. Moderate amounts of x-ray are beneficial where an infectious focus exists with malignancy. Patients past the menopause in Stage 1 or 2 rarely receive benefit from x-ray. If advanced or doubtful Stage 2, or if the growth has been rapid, preoperative therapy may

Illustration showing original limits of tumor, regression after 14 days x-ray and minimum limits of operative incision.

help. Older women do have radiosensitive tumors although the percentage is much smaller than in the younger age group. If found to be further advanced than suspected preoperatively, postoperative therapy should be given. This should commence as soon as possible before fibrosis from healing takes place. In a patient prior to the menopause whose history and examination suggest an estrogenic cause for the neoplasm, radiation castration should be carried out. At present sufficient statistics on such cases are not available from which conclusions can be drawn. Experimental work and a limited number of clinical cases indicate the procedure may be of value. Preoperative x-ray is of value only in cases having very radiosensitive tumors, therefore, if after a reasonable amount of x-ray has been given there is no marked regression of the tumor or metastatic

glands, x-ray should be abandoned and the operation performed immediately. This may be determined by the second week of treatment. Here again there must be close cooperation between the radiologist and surgeon. The amount of radiation will not noticeably delay healing. In cases where rapid regression has not been noted, I have found active cancer to exist in glands when they were removed at operation even though a complete series of x-ray had been given. This has been an important factor in causing me to change my opinion that preoperative x-ray was of value as a routine measure. X-ray therapy of sufficient intensity to be of value is not a harmless procedure and should not be used in cases where no benefits can be expected.

Patients with erythema, recurrences and metastases are primarily a radiation problem. Surgery may be indicated to give a patient relief from pain or from the mental anguish caused by a foul wound. Recurrences of gelatinous mammary cancer and cancers known to be very radio-resistant are best treated by surgery when possible.

Improvement caused by preoperative therapy should never be allowed to cause the surgeon to narrow his surgery. The skin incision should be planned and marked prior to preoperative therapy, otherwise the shrinkage of lesions may cause an incision to be made through skin previously involved and possibly harboring viable cancer cells. I have seen photographic evidence of this in clinics where the surgeon had no knowledge of the condition existing prior to the institution of preoperative therapy.

The patient who is considered inoperable when first seen is the radiologist's problem. She remains inoperable and no amount of improvement should change this opinion. Simple mastectomy, removal of gross scars and damaged skin constitute the maximum surgical intervention. Many of these patients survive more than five years. A few live out their life expectancy.

Both surgery and radiation should be carefully planned and executed. Inadequate surgery can not be compensated for by the use of radiation. Inadequate radiation is of no value as an adjunct to surgery. The combination of the two inadequately used does not constitute as good treatment as either well done.

Conclusions

1. Radical surgery is the effective agent in an overwhelming majority of the cases of breast cancer showing permanent cures.

2. Radium may be a useful adjunct to surgery in a few cases.

3. Preoperative and postoperative x-ray therapy produce a small percentage of increased cures and are valuable in selected cases. Radiation therapy increases comfort and extends life of incurable cases.

4. Close cooperation of all personnel and close coordination of all methods of therapy are essential.

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HUMAN FOOD NEEDS

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EARLY in the emergency and as a part of preparation for the possibility of war, governmental attention was directed to human needs for food. In the last war the country had a Food Administration under the directorship of Herbert Hoover. In this emergency the decision was reached to rely on existing agencies of government for what might be required in the matter of production and distribution of food. In addition an interdepartmental coordinating body was organized to direct the public education activity required. At present arrangements for dealing with food involve several separate departments of the government, with coordination effected through a Division of Nutrition in the Office of Defense Health and Welfare Services.

Heading the Division of Nutrition is Mr. M. L. Wilson of the Department of Agriculture and assisting him is Dr. Henry Sebrell of the United States Public Health Service. Dr. Sebrell's important contributions in nutritional physiology are widely known. The division is charged with the responsibility of assisting in the organization in each of the states, in cooperation with the State Defense Councils, of state committees on nutrition. Through these state committees informational material on selection and preparation of foods is to be disseminated throughout the country. Each state committee in turn is expected to aid in the organizing of community or county groups charged with arranging locally for instruction of the housewife and consumer. Mr. Wilson's long experience with the Extension Service of the Department of Agriculture fits him well to head this organization. The Extension Service, in fact, by its ramification throughout rural America, provides an ideal framework for the organization described. Unfortunately, the Extension Service does not reach into the cities. However, in urban communities other agencies and particularly the Red Cross, are enlisted for this service.

Public education is a job which of necessity involves the procedure of propaganda. The scientific discussion, in which physicians and scientists engage, encompasses a microscopic audience and a situation now exists in which it is important to get certain simple information to the masses. To make the problem still more difficult, the least well educated part of the population must be reached—the

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third who do not even read the daily press. They need this knowledge most, for they are the most poorly fed. What money they can use for food needs spending with increased discretion to get the nutrients they require in times of economic disruption such as are produced by war.

How to reach this third of the population is a technical problem with which physicians are unqualified to cope. The Division of Nutrition has decided, I think wisely, to enlist the experience in advertising and propaganda of certain industries—those engaged in distributing food. The American Grocers Manufacturers Association is one such agency. The National Millers Federation is another. These organizations are preparing promotional material designed to emphasize the need for more nutritious foods and to guide consumers in purchases of food. The advertising will be supervised by the Nutrition Division of the Office of Defense Health and Welfare Services, and although some of it may seem somewhat puerile to professional persons, I beg them to remember for whom it is intended and that such technics are indispensable to reach this group.

The Division of Nutrition is also enlisting the services of the radio and the press. To tell the story there, to those who need the message most, again involves technics which may prove disturbing to some critical persons of culture and education. However, you who hear the "Listen America" programs sponsored by the Federated Women's Clubs of America will agree, I think, that they have been well done. And again I beg you to hold in mind the fact that the problem involves instruction of the masses.

I especially hope that critics of the nutrition propaganda will take pains to discriminate between the general advertising sponsored by the government and the advertising of individual business firms or manufacturers. The latter is obviously beyond control except by the tedious processes of the law and many advertisers already are attempting to capitalize on the growing public interest in nutrition.

The material of all the advertising which has the endorsement of the federal authorities will bear the following statement: "Contributed in the interest of the National Nutrition Program of the Office of Defense Health and Welfare Services, Paul V. McNutt, Director." The advertising pieces will be signed by the industries preparing them, but will contain no reference to individual firms. Material which bears the statement I have quoted may not emphasize one class of foods more than another and the various classes of recommended foods will appear in every piece. Such material is designed to translate into popular terms the basic standards of the science of nutrition.

In all scientific matters the Division of Nutrition of the Office of Defense Health and Welfare Services is guided by advice from the National Research Council's Food and Nutrition Board. This Board, originally called the Committee on Food and Nutrition, was organized by the National Research Council of the American Academy of Sciences at the request of the Consumer Division of the National Defense Advisory Commission. The government has no voice in the selection of the members of any of the committees of the National Research Council, and this committee was organized without interference by the government. Among its non-voting members appear the names of certain government employees. However, they, like the voting members, were appointed by the executive officers of the National Research Council. The membership is principally composed of exponents of the science of nutrition from leading scientific institutions of the country.

One of the first requests to be made of the Committee on Food and Nutrition of the National Research Council was for a statement on the food needs of human beings. The set of recommendations of the Food Administration in the last war was out of date. Since then tremendous strides have been taken by the science of nutrition. In 1936 a technical commission of the League of Nations had issued certain standards, but even they were out of date. The vitamins, riboflavin and niacin have been discovered since the technical commission reported. (The designation "niacin" has lately been adopted as a synonym for nicotinic acid.) Individual judgments as to human requirements were based on conflicting reports of research and clinical findings and on data derived from work on animals. Thus a wide divergence in "requirements" existed in the current literature on nutrition.

The Committee, now the Board, decided early that its aim should be at a set of allowances which would provide for good nutrition—rather than at what might be termed a set of minimal requirements. The objective was a yardstick by which to measure diets and dietary progress.

With this in view the literature was critically appraised and in addition judgments were obtained not only from the nutritionists and physicians of the Board, but from many other scientific persons qualified to speak as experts in nutrition.* On the basis of the evidence obtained and of these judgments a table was prepared containing a set of recommended daily allowances for specific nutrients—calories, protein, calcium, iron and the vitamins. The original table

* The arduous labor of collecting and appraising the evidence was undertaken by a subcommittee headed by Dr. Lydia Roberts, head of the Department of Home Economics University of Chicago, and a member of the Council on Foods and Nutrition of the American Medical Association.

received further critical reviewing at the annual meeting of the American Institute of Nutrition and then with certain revisions was submitted for approval to the National Nutrition Conference which met in Washington, at the call of the President, in May, last year, to consider planning for nutrition. The table received the approval of that Conference.†

In considering these recommendations it is important to bear in mind the general policies which governed the action of the Board. The recommended allowances were to serve as a guide for planning good diets. Admittedly they call for more than minimal requirements. They provide a reasonable margin of safety, hence in no sense are to be confused with the minimal requirements more recently adopted by the Federal Security Agency for enforcement of the Food, Drug and Cosmetic Act. Only three members of the B group of vitamins were included in the table—thiamine, riboflavin and niacin. This was because, at the time, evidence of human need for the other members of the vitamin B complex, such as pyridoxine and pantothenic acid, was insufficient to permit decision as to daily requirements. It was pointed out, however, that foods supplying a sufficiency of thiamine, niacin and riboflavin will tend to supply what is needed of the remaining B vitamins. Similarly diets providing adequate amounts of protein, calcium and iron, will tend to supply other needed minerals not appearing in the table and requirement for which cannot now be named.

There is urgent need for continued research on the requirements of all the nutrients and this table in no sense is the last word on the subject. However, it is of interest and encouraging that the Scientific Advisers Division of the British Ministry of Foods, engaged in the same endeavor, has arrived independently at values for human nutrient requirements which closely parallel those proposed by the Food and Nutrition Board. The correspondence is indeed so close that the recommendations of the Board probably will be adopted by the British. They may, indeed, become an international standard.

The allowances of nutrients for adults are given for a man weighing 70 Kg. and a woman weighing 56 Kg. at three levels of activity. They require proportionate increasing or decreasing for individuals of other weights and other levels of activity. The allowances for protein are related exclusively to requirements for growth and for replacement of tissue. That physical exertions are accomplished at the expense of carbohydrate and fat, when these are available, was considered an established fact, and the assumption was

† The "Table of recommended daily allowances for specific nutrients" was published in the June 7, 1941, issue of the *Journal of the American Medical Association.*

made that diets commonly contain enough carbohydrate and fat to exempt protein from more than minimal utilization as food fuel.

The allowances for thiamine, riboflavin and niacin are proportional to the calories. This relationship has been established for thiamine. It was assumed for riboflavin and niacin since they, like thiamine, form parts of the enzyme systems of metabolism.

It is to be understood that these allowances are for persons in health and to be remembered that human needs are seriously affected by disease. For example, with fever or other conditions accompanied by elevation of the metabolic rate, the requirement for calories, for thiamine and certain other vitamins may be doubled. The need for vitamins and other nutritives may also be greatly altered by diseases of the bowel, which interfere with absorption.

It will be the responsibility of the organizations coordinated by the Office of Defense Health and Welfare Services, especially of community and county nutrition committees, to see that these recommended allowances of nutrients are translated into appropriate quantities of the foodstuffs available in specific localities. The public hears too much of vitamins from those engaged in exploitation of vitamin pills. The public needs to learn how to secure its requirement of vitamins and other nutrients from foods.

The allowances recommended can be provided by many different dietary patterns. One pattern, for example, is the following:

Milk, adults 1 pint (500 c.c.), children 1½ pints (750 c.c.) to 1 quart (1,000 c.c.).
Eggs, one egg 3 or 4 times a week.
Meat, 1 serving (1 ounce or 30 Gm. at 1 yr. up to 3 ounces or 90 Gm. for adults).
Vegetables, 2 servings, one green or yellow.
Fruit, 2 servings, one citrus or tomato.
Potato, 1 serving or more.
Butter, or oleomargarine containing vitamin A.
Bread.
Sugar and fat to complete the requirement of calories.

The choice of bread becomes of great importance when large amounts of bread are used in diets. The average per day per capita consumption of flour in this country is 6½ ounces (195 Gm.). Many persons eat less than this, and therefore others must eat more. Six ounces of flour in a diet will contribute from 20 to 30 per cent of all the calories of the diet. When the flour is ordinary white flour and another 15 per cent of the calories comes from sugar, as often is the case, the intakes of thiamine and niacin fall dangerously low. Use of whole grain or undermilled flour would obviate this difficulty, because wheat is a good source of thiamine

and niacin. Unfortunately, despite all kinds of effort to change this food habit, most persons want their breadstuffs white. The situation has been thoroughly explored by the Food and Nutrition Board, and the opinion of its members is unanimous that the quick action demanded by the emergency can only be obtained by putting thiamine and niacin in the bread the people like and eat—that is, in white bread. Enriched white breads and flours are now available in most communities. Regulation and control has been provided by the government, and flours and breads that are labeled "enriched" can be depended on with reasonable assurance to provide these vitamins, as well as iron, in amounts prescribed by regulation.

To return now to the table of recommended daily allowances for specific nutrients, the calories listed for adults range from 2,100 for a sedentary woman to 4,500 for a very active man. The daily allowance of food for a man engaged in moderate activity is 3,000 calories. These figures, in my opinion, may be somewhat high for populations in the Southern States. They more nearly represent requirements for more northern climates.

The protein allowance is set at 1 gram per kilogram of body weight for adult men and women, with proportionately greater provision for pregnant and nursing women and for children. Protein deficiency, I am told, is encountered not infrequently in certain populations in the South, owing mainly, I suppose, to the scarcity of lean meat.

The calcium allowances for the adult man and woman is 0.8 Gm., for women during pregnancy 1.5 and for lactation 2.0 Gm. All children should receive 1 Gm. or more; boys between 13 and 20 years, 1.4 Gm. These values are difficult to reach with diets not containing milk and what to do about this problem in certain regions of the South, where milk is scarce, is hard to say. It might be well in Southern States to put calcium into flour and bread. The federal regulations for enriched flour and bread permit calcium as an optional ingredient. I am inclined to the opinion that if laws are enacted by Southern States to make enrichment of bread and flour compulsory, calcium could advantageously be made a *required* ingredient. Calcium deficiency is responsible for much osteoporosis among older persons and undoubtedly contributes to mild forms of tetany and to several other human ills.

Phosphorus was not named in the table of recommended allowances for specific nutrients, for the reason that there is little danger of its lack in any diets. Iron anemia, on the other hand, is prevalent and attention to the iron content of diets will be very beneficial. The allowances for iron conform to commonly accepted values.

They are 12 mg. daily for the adult man or woman, 15 mg. for the pregnant woman and 15 mg. for boys and girls more than 12 years of age.

The value set for vitamin A was 5,000 international units for adult men and women. For pregnant women 6,000 units was recommended, and for women during lactation 8,000. This assumes that the beta-carotene precursor of vitamin A provides a reasonable share of the total. The requirement may be less if all is obtained as vitamin A. It may be greater if the chief source is the pro-vitamin beta-carotene. The Scientific Advisors Division of the Ministry of Food in England adopted the figure 4,600 international units for adults, not including nursing or pregnant women.

The recommended allowances of the Food and Nutrition Board for thiamine vary with the calories and provide 0.6 mg. for each 1,000 calories. This figure allows for loss in cooking, but not for much loss. The experiments of my associates on human subjects have revealed that diets which contain, as eaten, 0.25 mg. per 1,000 calories invariably provoke objective symptoms of thiamine deficiency, and that subjective symptoms may be evident with anything less than 0.5 mg. per 1,000 calories. The British figure for the daily requirement of thiamine of the population as a whole was 500 units, or 1.66 mg. This roughly conforms to the recommendation of the Board for the sedentary man getting 2,500 calories. It is 1.5 mg. Pregnancy has been shown to increase the thiamine requirement and 1.8 mg. was the value set for pregnant women. In my personal opinion this is low. I would provide for 3.0 mg. daily during pregnancy. A more liberal allowance was recommended for nursing women, namely 2.3 mg.

The evidence appears to indicate that the requirement for riboflavin is related to that of thiamine in a ratio of about 1.5 to 1. Therefore, in the table, since the thiamine allowance was set at 0.6 mg. for each 1,000 calories, the recommended allowance for riboflavin was made 0.9 mg. for each 1,000 calories. This for a moderately active adult male amounts to a daily allowance of 2.7 mg. The Scientific Advisor Division of the Ministry of Food of Great Britain arrived independently at a human requirement of from 2 to 3 mg. daily.

No entirely satisfactory evidence is as yet available as to the daily human requirement for niacin (nicotinic acid), but from observations on dogs and from what is known about the niacin content of the diets of people who have pellagra, the consensus was reached that here too a relationship existed, proportional to the caloric intake, and that this approximated ten times the relationship between

thiamine and calories. Therefore, 6 mg. per 1,000 calories was accepted as the daily allowance of niacin desirable. It probably is liberal, since loss from cooking in the case of niacin is insignificant. The British figure for niacin is 15 mg. as a requirement for the population as a whole. The daily allowances recommended by our Board range from 15 to 23 mg.

Ascorbic acid (vitamin C) aroused much discussion in the deliberations that preceded the recommendation relating to its provision. The British after reviewing the evidence arrived at a value of 50 mg. for the population as a whole, not including pregnant or nursing women for whom admittedly the requirement is doubled. The Board's recommendation for adults was a daily allowance of 75 mg. The discussion centered about the question of the protective action of this vitamin in various infections. Admittedly much less than 75 mg. will prevent scurvy. Indeed, information suggests that the population of the British Isles without showing scurvy is receiving today considerably less than the 37.5 mg., which was named as the minimal requirement in the regulations set up under the Food, Drug and Cosmetic Act.

There appears to be no clear evidence at present to show that adult persons require more vitamin D than they obtain from exposure of their skins to the sun. For children under 12 the best controlled studies suggest that the daily requirement is in the neighborhood of 350 U.S.P. units. The Board chose the value 400 U.S.P. units as the allowance to be recommended in childhood, and suggested that adults not exposed to sunshine should also receive this amount. For pregnant and nursing women the evidence indicated a higher requirement, and from 400 to 800 units was recommended.

I now wish to emphasize that as physicians it is our responsibility to do what *we* can do to get this information, suitably translated into understandable terms of common foods, to our patients and their families. The medical profession has been strangely apathetic on the subject of nutrition. This apathy persists despite the fact that over the last twenty years one group of our confreres, the pediatricians, have demonstrated conclusively on infants the advantages of careful food selection. There seems to be no doubt that malnutrition contributes importantly to many diseases and that more attention to dietetics in hospitals and medical practice generally will contribute significantly to the effectiveness of therapeutics in general. I personally regard it as regrettable that dietetic matters are entrusted so exclusively to nurses and dietitians, and am confident that a more lively interest in the subject on the part of the physicians and surgeons would be very well repaid.

In this connection I wish to call attention to the possible danger in many cases which attends the common practice of long-continued administration, parenterally, of solutions of dextrose. Several of my friends who practice in the Southern States, in sections where pellagra is encountered frequently, have commented that one of the quickest ways to provoke the symptoms of this disease, in patients who are on the borderline or in a state of prepellagra, is to inject dextrose intravenously. The explanation is not far to seek. Body stores of the co-enzymes required for cellular oxidations are likely to be extremely low in such cases and injection of dextrose quickly depletes the tissues of what stores remain. As a result evidence of acute deficiencies appears. This relates in particular to lack of niacin, riboflavin and thiamine, the vitamins which enter into the structure of the co-enzymes of respiration. Stimulated by these considerations I have been urging the administration of these three vitamins in all cases of patients who receive injections of dextrose. The results have been gratifying. The severity of nausea after operations apparently has been minimized by this procedure and the incidence of anorexia as well as that of ileus seems to have been diminished.

This observation led me to suggest to my colleague, Dr. Jesse Bollman, of the Institute of Experimental Medicine in the Mayo Foundation, that he subject the matter to experimental testing with animals. He has done so with results as follows: Rats were placed on a diet low in vitamins of the B complex for a period long enough to lower but not completely to deplete their body stores of B vitamins. They then were divided into two lots and both lots were fed nothing but dextrose, partly given by stomach tube. One lot, in addition to the dextrose, received several of the vitamins of the B complex, including thiamine, niacin and riboflavin. The other lot received no vitamins. The rats fed the dextrose with the vitamins all survived for more than three weeks. They ultimately died from lack of other nutrients, as should be expected. However, the rats receiving dextrose without the vitamins mostly died within ten days. The experiment was repeated giving only thiamine with the dextrose, and the result was about the same. The equally good result using only thiamine is probably explained by the fact that the co-enzyme, co-carboxylase, to the synthesis of which thiamine contributes, is depleted much more quickly than are the co-enzymes which involve the other vitamins.

I propose, therefore, when dextrose is given parenterally to patients, that thiamine at least should be administered with it. The dose I have used is 5 mg. given parenterally once or twice each day, either in the same solution as the dextrose or separately. In addi-

tion it probably likewise will be advantageous to use niacinamide in a dose of 50 mg. once or more times daily. This can be incorporated in the solution of dextrose. Riboflavin also may be indicated. Owing to its rapid deterioration on exposure in solution to light, it is less feasible to incorporate riboflavin in the solution of dextrose. A dose of 7.5 mg. of riboflavin once or twice each day would certainly suffice.

In closing I wish to point out that the nutrition teaching program of the Office of Defense Health and Welfare Services does not include recommendations for self medication with pharmaceutical preparations of vitamins or vitamin concentrates. This is on the advice of the Food and Nutrition Board of the National Research Council. The Board fully recognizes that such preparations are necessary for the successful treatment of the frank deficiency states. It believes, however, that cases of frank deficiency should be under the care of physicians who are technically qualified to use such preparations properly, and that the indiscriminate consumption of vitamins, as such, by technically unqualified persons is unwise and to be discouraged. In any case, it is obvious that the foundation of the treatment of any deficiency state, mild or severe, should be a diet which fully meets in all particulars the recommended daily allowances for specific nutrients of the Food and Nutrition Board, and that for mild cases of deficiency such a diet, as a rule, will provide not only all the vitamins required, but also other nutrients such as protein, calcium and iron which usually are also lacking in the diets of persons who acquire deficiency diseases.

A MODIFIED MOULDED SPLINT FOR FRACTURES OF THE SHAFT OF THE HUMERUS

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THE shoulder spica cast as a postoperative dressing after reduction of fractures of the shaft of the humerus is objectionable for several reasons. One reason is that it is not an effective splint.

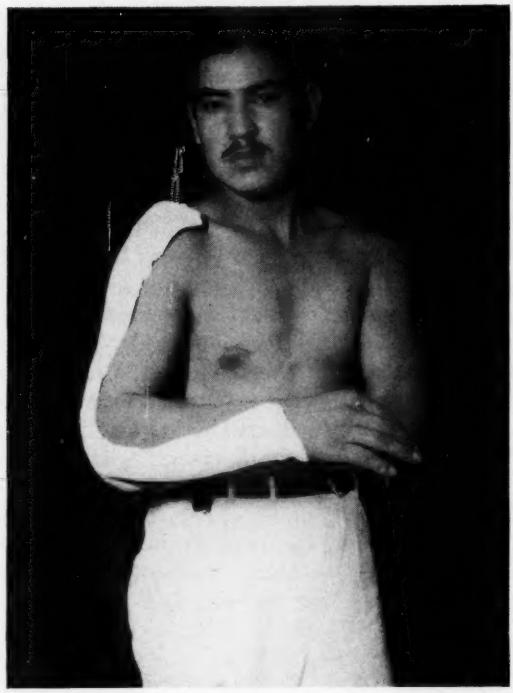

Fig. 1. Posterior moulded splint applied from shoulder to hand.

Even though carefully applied it is difficult to get a grip on the patient's shoulder and the cast soon loosens up until there is a good deal of space between the patient and the cast in the regions of the shoulder and upper part of the arm. Another objection to the shoulder spica is that it is very uncomfortable.

We have been using a modified posterior moulded splint for the last four years with good success. We have recently learned that Smith-Petersen[9] has been using for some time a circular cast from

the hand to the axilla and holding the cast to the shoulder with an elastic bandage. He employs this as a postoperative dressing in fractures of the shaft of the humerus.

The use of the hanging cast[2] for fractures of the upper end of the humerus, represents another method of eliminating the objectionable spica cast or the perhaps equally objectionable airplane splint.

Fig. 2. Woven elastic bandage applied over the moulded splint.

We feel that our arrangement is superior to the shoulder spica cast and it is applied in the following manner as shown in the illustrations. A moderately heavy posterior moulded splint is applied extending from just lateral to the base of the neck, over the point of the shoulder running somewhat posteriorly, down the posterolateral aspect of the arm, posterior aspect of the elbow, inferior aspect of the forearm and extending to the middle of the hand. The arm is hanging straight down, the elbow is at a right angle and the wrist is straight. The fingers are not included. A generous pad of sheet wadding is placed in the axilla and a small pad in the ante-

cubital fold. The moulded plaster splint is applied and held on with ordinary gauze roller bandage. When the plaster has set thoroughly two woven elastic bandages (of the Ace type and containing no rubber or latex) are applied over the gauze bandage, after first loosening any tight bands of the previously applied gauze bandage. We feel the use of the woven elastic bandages is im-

Fig. 3. Harness-like arrangement applied over the moulded splint and woven elastic bandage.

portant because it keeps the posterior moulded splint snugly applied and at the same time supports the circulation rather than constricting it. Following application of the splint the forearm is placed in a sling of 6 inch muslin bandage and another piece of the same bandage is run around the upper arm and body and pinned to itself and to the woven elastic bandage. These two muslin bandages serve to hold the arm steady while a harness-like piece of apparatus is being made by a corsetiere. The corsetiere makes a custom made shoulder piece, a forearm piece (a modified sling) and a wide band for the upper arm. All of these are made of duck or similar material with straps and buckles and are fully adjustable. The arrange-

ment of the various pieces may be seen in the illustrations. While the harness-like apparatus may seem a little complicated we feel it greatly increases the stability of the arm by fixing it snugly to the patient's side. One may vary the arrangement or even continue on permanently with the temporary muslin bands but we have felt the apparatus described is much safer. If the moulded splint seems to become loose the woven elastic bandages may be removed and re-applied more tightly.

We have employed this method in simple fractures of the shaft of the humerus without displacement, after closed and open reductions and after bone graft operations and feel that it is both efficient and comfortable.

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THE USE OF HUMAN PLASMA PROTEIN SOLUTIONS IN SURGERY

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ONE of the important problems in the surgical field concerns the maintenance of the proper amount and composition of the various fluids in the body. These fluids have been classified according to their position and composition into the intracellular and extracellular portions. The former, which makes up 50 per cent of the body weight, occurs within cells and has the potassium ion as its chief cation. The latter, with a preponderance of sodium ion, comprises 20 per cent of the body weight and has two major subdivisions. That portion located outside the blood vessels and between body cells is called the interstitial fraction (15 per cent body weight). The remainder of the extracellular fluid (5 per cent body weight) is normally located within the blood vessels and is called the plasma fluid. The presence of a significant concentration of proteins (6.0 to 8.0 Gm. per 100 c.c.) in the plasma fluid makes it differ considerably from the interstitial portion.

These fluids can also be considered from the standpoint of their functions. The plasma fluid is a circulating fraction and as such it has to do with the distribution of certain substances within the body. Thus the circulating plasma acts as a medium of red blood cell transport; it conveys food substances, hormones, antibodies, water, electrolytes to various parts of the body. It also has to do with the removal of waste products and the maintenance of the acid-base balance. Another circulating fluid is the lymph which has to do with the distribution of fats and other materials.

The interstitial and intracellular fluids can be considered as essentially non-circulating in nature. The interstitial portion acts as a reservoir and a medium of exchange. It supplies water to both plasma and cells and substances travelling between these two points must ply this route. The intracellular fluid receives dissolved substances brought to the cell, furnishes a medium for cell metabolism

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and helps in discharging waste products and secretions from the cell.

In several conditions seen by the surgeon, alterations in these various fluids take place. These alterations may be attended by an increase or decrease in the volume of one or more fluid compartments or by a decrease in one compartment and an increase in another. Changes of such nature may be of little consequence to the patient, or they may be very dangerous or even fatal. A few examples taken from experimental data might clarify this point. Following hemorrhage there may be an inrush of fluid into the blood stream in an attempt to maintain the blood volume[1]. Recent observations suggest that this fluid may be partly obtained from cells[2]. On the other hand, if hemorrhage is sufficiently severe to produce marked anoxemia[3], there appears to be a decrease in extracellular fluid with an increase in intracellullar water. Similar effects are probably found in anoxemia due to other causes[4]. In Addison's disease during crisis[5] or in experimental conditions simulating it[6], the water content of cells appears to increase. It seems probable that the intracellular edema[7] seen microscopically in acute parenchymatous degeneration represents an increase in intracellular water. Water intoxication is apparently accompanied by an increase in intracellular water[8]. Such examples demonstrate how an increase in cellular water can occur at the expense of the extracellular compartment. In late freezing shock in dogs[9] there is a severe decrease in the plasma volume, and a definite decrease in the extracellular fluid which is interpreted as demonstrating an increase in intracellular water. Somewhat similar changes have been described by Barbour[10] in experimental fever. Severe hypoproteinemia produces a decrease in plasma volume[11] and an increase in interstitial volume leading to edema. In advanced dehydration associated with pancreatic[12], or biliary fistula[13] there is eventually a decrease in plasma and interstitial volume.

These examples demonstrate how in disease the water in the body may be shifted from a location where it is vital (plasma) to a place (interstitial or cells) where its presence in greater quantity may not be needed or may even be deleterious.

These alterations in the fluid distribution in the body can be influenced, and to a large degree controlled by the proper use of intravenous plasma protein therapy. Recent data tend to indicate that concentrated plasma is not only able to shift fluids from the interstitial reservoir into the blood stream but also is able to draw fluids out of cells under normal conditions[14] and in experimental shock[9].

Dry plasma obtained by desiccation from the frozen state[15, 16] is superior to liquid plasma preparations. This superiority is not only due to technical advantages[17], such as safe indefinite storage

at room temperature, but is due to the fact that the choice of concentration is available. By this is meant that concentrated, normal or dilute plasma can be prepared from the dry product by varying the amount of water or saline used as solvent.

The use of plasma protein therapy in surgery can be discussed under four major headings: shock, nutrition, edema and dehydration.

Shock

In 1936 Hughes et al.[18] suggested that concentrated serum should be effective in the treatment of traumatic and surgical shock. During the past two and one-half years as a result of extensive clinical[19, 20] and experimental[21, 9] trial, we have strongly advocated that concentrated plasma or serum rapidly administered by intravenous route constitutes the best solution for shock therapy. Before discussing additional data supporting this contention, it is advisable to consider a few of the accepted changes in the body during shock.

It appears that regardless of the initial cause, one of the main mechanisms in the sustaining of traumatic or posthemorrhagic shock is the presence of a disproportion between the peripheral vascular capacity and the circulating blood volume. This disproportion is the result of two main factors. Most often there is an actual decrease in the blood volume. This decrease may result from the loss of whole blood (hemorrhage) in which case there is usually a tendency toward dilution of the remaining red cells, a condition known as hemodilution; or, there may be a loss of plasma, as observed in the widespread capillary damage of burns, which gives rise to a concentration of the red cells, i.e. hemocytoconcentration; or finally, both of these factors may operate together, under which condition the hemocytoconcentration may be obscured, depending on which is dominant. This latter possibility seems to explain the apparent absence of hemocytoconcentration in many cases of early clinical shock. The disproportion may be accentuated by an increase in the vascular capacity. This may be due to either arteriolar[22] or capillary dilatation[23], the latter being encountered in the later stages of shock.

In conjunction with the development of this disproportion definite alterations in hemodynamics occur. There is a decrease in the venous return to the heart, a decrease in cardiac output, a decrease in the amount of oxygen transported to the tissues (hypoxia); and later with diffuse capillary damage, increased quantities of plasma are lost, and a vicious cycle is said to develop[23].

Sooner or later a drop in the blood pressure is quite definite although early this may be obscured by vasoconstriction. The pulse is usually elevated and weak, although occasionally the pulse rate may be normal. Peripheral vasoconstriction causes a distinct pallor of the skin. The patient becomes restless, may have maniacal episodes, may be lethargic or comatose.

It is also important to visualize what changes occur in the tissues as shock proceeds. In early shock, that is, within the first two or three hours, there may be no change or only minor changes in the tissues[24]. As time goes by certain definite tissue changes develop. Outstanding among these are diffuse capillary dilatation and congestion, capillary hemorrhages, edema and marked acute parenchymatous degeneration (intracellular edema).

The body fluids are likewise altered. There is a decrease in the plasma volume which may be associated with an increase in the intracellular fluid. There is oliguria or anuria due to a decrease in the glomerular filtration rate[3], the non-protein nitrogen of the blood is elevated and acidosis becomes progressive[9, 25]. The stagnant circulation may decrease the hormone distribution in the body with possible unfavorable consequences to cellular metabolism. At an ill-defined interval in this chain of events these changes are thought to become irreversible.

From these considerations it becomes apparent that the main aim of shock therapy is to replace the lost blood volume early thus accelerating the circulation before these changes are irreversible. This process has been termed replacement therapy. Obviously, the more rapid the replacement, the more efficient is the therapeutic agent. Even more effective is the use of measures which go beyond replacement and tend to rectify or reverse abnormal changes.

Saline solutions (most commonly used as 5 per cent glucose in saline) fall quite short of this attainment. They increase the blood volume very transiently and there are risks attached to their use because they dilute the plasma proteins thus diminishing the effective osmotic pull. Furthermore, they may actually "wash" proteins out of the blood stream[9, 26, 27].

The role of whole blood transfusions is not as important as previously considered. The red cell depletion has to be very grave[28, 29, 30] before fatal anemic anoxia develops. On the other hand, if the blood volume be maintained, even in cases with severe hemorrhage, the case can be adequately carried through the period of emergency. The anemia can be coped with later when time is not such a valuable factor.

That plasma protein solutions offer more therapeutically in shock than other solutions is a concept which is rapidly gaining wide acceptance. In these solutions it is their protein content that makes them valuable. The proteins tend to hold water within blood vessels and by this means maintain the circulation.

Thus far these protein solutions have been successfully administered in three forms: as dilute plasma (protein content 3-4 Gm. per 100 c.c.)[31], as normal plasma (protein content 5-7 Gm. per 100 c.c.[32]) and as concentrated plasma (protein content 15-20 Gm. per 100 c.c.[33, 19, 20]). There is disagreement as to which has the greatest therapeutic advantage, although almost everyone concedes that properly prepared concentrated plasma given in syringes is the most easily administered form.

In order to appraise the efficiency of these various solutions, let us consider what happens to them when they are given intravenously. Half of the volume of dilute plasma is normal saline. This saline is handled by the body just as other saline solutions and passes rapidly into the tissue spaces, or into the urine in a short period of time. Only the protein containing half of this solution remains in the blood stream[34, 9]. There is evidence that again the outgoing saline may wash out some of the protein[24, 9]. In addition, in order to give effective quantities of protein one must administer very large volumes, i.e. between 2000 and 5000 c.c.

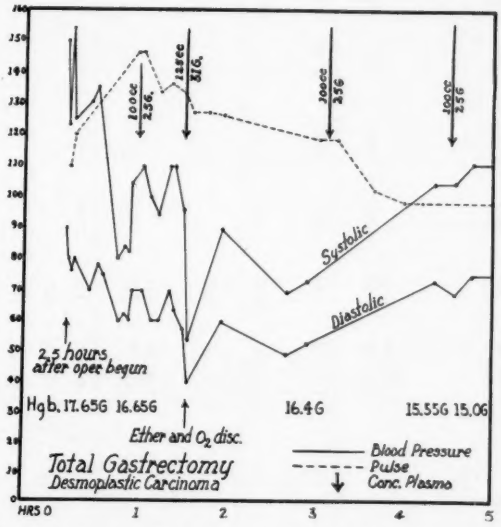
In our opinion normal plasma is more effective than dilute plasma in the treatment of shock because its protein content is greater per unit volume. The introduction of such an isotonic solution again requires large volumes and there is no tendency to shift fluids from misplaced locations.

Concentrated plasma, however, exhibits a still greater therapeutic effectiveness. A few seconds after injection it reaches the capillary beds and in this location pulls water from the tissues into the blood stream because of its great protein concentration. In the normal individual this shift of water is but an accentuation of the physiologic mechanism whereby the vital circulating plasma volume is defended by the tissue fluid reserve. In shock where badly needed fluid has already shifted from the circulation to the tissues, the use of concentrated plasma is not only entirely physiologic in its action but constitutes a corrective force tending to reverse this shock mechanism. There is also evidence that water is given up by swollen cells with a return to a more normal state. Furthermore with this type of therapy there is a greater tendency for the shifted water to remain intravascular since once an adequate circulation is re-established there is less apt to be plasma loss. In shock these effective

changes are obtained from the intravenous administration of large quantities of protein in a short interval of time, that is, 15 to 30 Gm. of plasma proteins in 3 to 5 minutes' time.

The cases in the table and graph demonstrate the effects of concentrated plasma in shock. Five of the six cases in the table were observed in the emergency service of the city-county hospital.

These five cases included gunshot wounds, lacerations and fractures and were selected because they resemble war casualties. The other two cases, table and graph, are cases of surgical shock. All cases were observed and treated within two hours after the precipitating cause or within two hours after shock became apparent.



This graph demonstrates the blood pressure and pulse responses to concentrated plasma therapy in surgical shock. The concomitant hemodilution is shown by the decrease in hemoglobin concentration. The blood pressure drop occurred about three hours after the operation began. No other fluids besides concentrated plasma were given. The patient recovered from the operation and later was discharged from the hospital. The plasma solution was prepared by dissolving 25 Gm. of the dry product in 100 c.c. of solution.

NOTES ON THE TABLES ON PAGES 420 AND 421.

Under "Remarks," each remark is considered the zero hour for the subsequent remark: thus in Case 1, "Therapy 5.5 hr." means therapy 5½ hours after the patient was first seen in shock; "17 min." means 17 minutes after last treatment, or 5 hours 47 minutes after first seen. "Time Inj. Mins." indicates the number of minutes required for injection. "G %" indicates the number of grams of plasma protein per 100 c.c. "T. Prot. Gm." means the total protein content of the plasma solution used. "B.P." is blood pressure of course, and "P." pulse. "Pl. V." plasma volume in cubic centimeters. "WBV." whole blood volume in cubic centimeters. "PPConc." plasma protein concentration in the patient. "TCPt." total circulating proteins. "Hmt." hematocrit reading. "Hgb." hemoglobin. "ExW." extracellular water. "IntW." interstitial water.

TABLE OF CASES

Type Case	Remarks	Time	Conc.	Pl.	Therapy	B.P.	P	PlV.	WBV.	PPConc.	TCPt.	Hmt.	Hgb.	ExW.	IntW.
	from 0 hr.	Inj. Mins.	Amt. cc	Conc. G%	TProt. Gm.	mmHg		cc	cc	G%	Gms	%	G%	cc	cc
I	Shock					66/30	140	2884	4542	5.6	161.5	36.5	12.0	19900	17016
Age 24.															
Stab wound chest.	Therapy 5.5 hr.	5	145	16.6	24.07										
Hemo-pneumo-thorax.	17 min.					94/54									
Lived	2 hrs.					114/68	130	4054	5970	5.6	227.0	32.1	11	24000	19946
	Sustained														
II	Before operation					110/70	86	2054	3367	5.35	109.8	39.0	10		
Age 55.															
Ca cecum.															
Deficiency state.	Shock at op.					Imper-cepti-ble	Imp.								
Bowel resection.	Cyanosis														
Lived	Therapy														
	a. 20 min.	9	240	14.4	34.56										
	b. 1 hr.	6	85	18.2	15.47	124/84	Perc.								
	3 hrs.					114/74	120	2343	3430	6.15	144.0	31.7	8.5	16953	14610
	Sustained														
III	Shock					85/65	100	2500	4310	7.7	192.5	42.0	13.2		
Age 33.															
Car wreck, multiple fractures.	Therapy 1.5 hrs.	20	136	18.8	25.6										
Lived	10 mins.					100/70	100						12.0		
	30 mins.					90/60									
	Therapy 30 mins.	12	305	16.0	48.8										
	Immediate					120/80	108								
	15 hrs.					118/82	96	4166	6249	7.7	328.7	33.5	10.8	13103	8937

Type Case	Remarks	Time Inj. Mins. from 0 hr.	Conc. Pl. Therapy Amt. cc	Conc. G%	TProt. Gm.	B.P. mmHg	P	PlV. cc	WBV. cc	PPC G%	TCP Gms	Hmt. %	Hgb. G%	ExW. cc	IntW. cc
IV	Shock					90/70									
Age 33.															
Laceration neck,	Therapy 1 hr.	5	140	18.0	25.2										
Larynx exposed	10 mins.					108/90	118								
Emergency tracheo-tomy	3 hrs.					78/54	116								
Lived	Therapy	4	85	18.0	15.3										
	20 mins.					108/68	132								
	3 mins.					78/54									
	15 mins.														
	Therapy	4	100	18.0	18.0										
	20 mins.														
	5 mins.					100/70	128								
	Sustained					120/80									
V	Shock					54/38	120	3409	5165	5.55	189.5	34	11.1		
Age 29.	Therapy	(a)													
Gun shot wound:	2.5 hrs.	5	115	14.6	16.8	104/80									
		(b)													
Trauma of kidney,		8	190	16.8	31.9	126/88									
Perforation diaphragm	1 hr. Sustained					130/84	118	4171	6043	6.25	261	30.5	10.15	17000	12829
Nephrectomy	1 hr.					136/82	108			6.55			9.5		
Expired several days later															
VI	Shock					70/50	133	3000	5000	6.4	192	40	11.1	18700	15700
Age 43.															
Gun shot wound, intes-tinal perfora-tion	Therapy		837	15.0	125.5										
	(a) 5.5 hr.					120/66	140	3750		6.7	250	30	9.8		
	(b) 30 min.														
	Terminally		120	14.55	17.0	Imp.	Imp.	Exp.							
	Expired														

All cases displayed clinical signs of peripheral circulatory failure, that is, a depression of the blood pressure, a rapid and weak pulse, peripheral vasoconstriction causing a cold and pale skin, and a decreased venous return to the heart as demonstrated by partially collapsed peripheral veins below the level of the heart. Sweating was usually present and cyanosis was occasionally perceptible.

Methods: The plasma used was prepared as outlined earlier.[35] The citrated blood is collected into vacuum bottles. After chilling, all different types of blood are pooled together in the same reservoir in order to remove the agglutinins and the plasma is promptly separated and clarified by means of two De Laval separators. The plasma is then filtered through a Seitz filter with the aid of filter-cel and desiccated from the frozen state[15]. The concentrated plasma was obtained by dissolving the dry powder in a decreased volume of water so as to give a total protein concentration varying between 14.4 and 18.8 Gm. per 100 c.c. The plasma was injected intravenously with 50 or 100 c.c. glass syringes as rapidly as possible. On each occasion, just before the needle was introduced into the vein a 1 to 2 c.c. sample of the concentrated plasma solution was placed in a test tube for the protein determination. Each case was observed for a sufficient interval of time, as suggested by the English workers[36], in order that clinically it could be considered to be true hematogenic shock. This interval is designated in the table as the interval from the zero hour, which signifies the time the patient was first seen. The blood pressure, as taken with an ordinary mercury sphygmomanometer, and the radial pulse were followed closely during shock and after treatment. The rate of injection was noted. The blue dye method[37] was used for plasma volume studies. The Greenberg[38] method was used for total plasma proteins. The hematocrits were determined according to Wintrobe[39] and the Sanford-Sheard[40] technic was used for the hemoglobin concentration. The extracellular water was determined as the water available for solution of sodium thiocyanate[41].

The plasma volume and the total circulating plasma proteins were determined during shock and within a few hours after treatment. There was usually insufficient time to determine the volume of extracellular water during shock. This procedure was usually carried out a few hours after treatment in order to attempt to determine the presence or absence of dehydration.

These patients received no other parenteral fluids beside concentrated plasma until the next day following the recovery from shock. One case (No. 6) received 1500 c.c. of blood during the removal of the traumatized kidney. Shock developed one and one-half hours

after the operation. From then until the shock was completely controlled no other fluids beside concentrated plasma were given.

Results: In six of the cases presented the blood pressure elevation occurred rapidly. It was well above an assumed critical level of 80/40 within 15 minutes and at its sustained level (100 plus/80 plus) within one hour. Case 6 with intestinal perforation had passed the commonly accepted deadline of six hours before operation. This patient required the injection of 772 c.c. of concentrated plasma in a period of 5 hours before the blood pressure reached 102/66. It was maintained at this level throughout the first half of the operation for the repair of multiple perforations of the intestines but the patient died in shock just as the anesthetic was being discontinued. In this case the pulse rate was at all times very rapid although in the other cases the pulse decreased as the blood pressure increased.

The plasma volume following concentrated plasma injections was increased in all cases, usually in proportion to the grams of protein injected. Case 2 developed severe shock during the anesthesia. It was impossible to determine the plasma volume in shock so the actual increase after treatment is not known. However, the plasma volume after therapy was greater than before the operation.

In all cases there was a definite increase in the total circulating proteins. The protein concentration remained almost the same, signifying an increase in plasma volume due to the withdrawal of fluid into the blood stream. The increase in the total circulating protein was at times greater than would be expected from the injected quantity alone. Whether this indicates that the fluid withdrawn into the blood stream contains protein or not we cannot state at present. However, in recent experiments[9], such a possibility was suggested.

Along with an increase in the plasma volume there was an expected decrease in the hematocrit and hemoglobin concentration. This hemodilution has been frequently observed in the past[19].

The water available for the solution of sodium thiocyanate (extracellular water) was calculated in four of these cases in an attempt to determine the presence or absence of dehydration following the injection of substantial quantities of concentrated proteins in shock. In the four cases the figures were within normal limits indicating that rapid dehydration did not develop in these cases. Case 1 suggests an increase in the extracellular compartment possibly by the withdrawal of water from cells.

Nutrition

Plasma proteins can be used by body cells for their protein metabolism[42]. This means that plasma can be administered intravenously with beneficial effects to those cases unable to take food by mouth, such as cases having gastrointestinal operations. Along with the administration of glucose, electrolytes and vitamins it makes for a more balanced parenteral food intake. The liver is considered to be better protected from damage[43].

Such proteins may be given in normal, dilute, or concentrated form. We have found it simpler to inject the protein intravenously in concentrated form, i. e. 15 to 20 Gm. per 100 c.c.

The administration of plasma in nutritional emergencies as severe hypoproteinemias due to gastrointestinal lesions, seems preferable because the entire protein complex is more available for metabolism. In general use, however, aminoids or other substitute[44] preparations with or without plasma may suffice, or be more economical.

Edema

Edema in the surgical patient may be due to low plasma protein levels with or without an excessive intake of sodium. Such edema is important because it may retard wound healing[45, 46, 47], encourage pulmonary edema or pneumonia or prevent the proper amount of fluid from reaching the kidney (prerenal deviation). Saline edema usually develops when other complications are present, such as low plasma protein level[48a] or an infection[48b].

These considerations emphasize the importance of ascertaining and elevating when necessary the patient's total circulating plasma proteins before major operations.

Ravdin et al.[49] have pointed out that a proper plasma protein level decreases the possibility of edema about gastrointestinal stomas thus encouraging healing and decreasing the possibility of postoperative obstruction.

Two points must be kept in mind in the treatment of edemas. First, the sodium intake should be limited because all edemas seem to be associated with sodium retention. Second, the plasma proteins should be given in concentrated form to increase the plasma volume and encourage the renal plasma flow. When the salt intake is decreased the kidney rejects more water and the edema decreases. Recently Scott[50] has discussed the use of diuretics in enhancing the tubular rejection by the kidneys.

Dehydration

In dehydration there is a loss of fluid from the body. Such may occur from gastrointestinal fistulas, prolonged vomiting, severe diarrhea or following prolonged periods of copious sweating. The decrease in the volume of extracellular fluid affects its two components, i. e. plasma and interstitial fractions, differently. According to Gamble[12] the interstitial compartment, serving as a reservoir, maintains the more essential circulating plasma volume as long as possible. The plasma volume decreases only after a large fraction of the interstitial portion has been depleted. This late change can be followed by an increase in the concentration of the plasma proteins.

Gamble[51] and Butler[52] also emphasize that in severe dehydration the problems of therapy are not confined solely to the replenishment of the volume and composition of the extracellular fluids. The presence of a negative protein metabolism must be corrected and the blood flow (plasma flow) through the kidneys must be encouraged. On these premises it is advisable to administer plasma proteins to dehydrated patients. Early in the treatment dilute plasma can be given intravenously or saline can be given by hypodermoclysis and concentrated plasma intravenously. Later as hydration proceeds concentrated plasma offers a means of increasing the renal plasma flow and encouraging the re-establishment of water and electrolyte balance by the kidneys.

Discussion

Concentrated plasma with a protein concentration between 15 and 20 Gm. per 100 c.c. is very beneficial in traumatic and posthemorrhagic shock because it shifts fluids from a location where it is not needed by the body to one where it is of vital importance for the maintenance of the circulation. This shift is due to the increased osmotic property associated with a greater protein concentration. Since in advanced cases of shock the body cells may take up water, this shift appears to reverse certain abnormal physiologic mechanisms.

Concentrated plasma has technical advantages over other forms of plasma in that it is prepared from desiccated plasma which can be safely stored at room temperature and it can be given with ease in standard syringes. However, its greatest advantage is therapeutic because with it more protein can be administered per unit time than by other methods.

As recently mentioned by Strumia[53] the protein content of any plasma solution is very important. This is true because the increase

in the plasma volume in shock, the discouragement of edema and the nutritional value of plasma all depend on the amount of protein injected. Therefore, it is urged that the physician administering plasma should be aware of how much protein is being injected. Such terms as "four times concentrated" should be replaced by the exact protein concentration. This question is being discussed elsewhere[21].

It is also important to consider the method and rate of administration of the plasma. We insist that in severe traumatic and posthemorrhagic shock concentrated plasma should be given rapidly, i. e. 100 to 200 c.c. (or 15 to 20 Gm. of protein) in three to five minutes. It is impractical to administer concentrated plasma by drip method. It should be given in syringes.

Recent objections to the use of concentrated plasma in shock should be analyzed. Newhouser and Kendrick in their recent report[54] rejected concentrated plasma as ineffective in shock and recommended a more dilute form (normal plasma). At the same time enthusiasm was expressed for further trial of concentrated human albumin solution as prepared by Cohn[56]. Since the mode of action of all properly prepared concentrated protein solutions is identical, varying only in degree as influenced by the concentration, it is difficult to follow this reasoning. Furthermore, these conclusions[54] based on 21 packages of plasma administered in concentrated form, unfortunately were not accompanied by such essential data as the type, severity and duration of the shock, the rate and method of administration, the protein content and the volume given. Without such data it is difficult to decide whether such cases were adequately treated or not.

Mahoney, Kingsley, and Howland[55] after a series of experimental observations concluded that dilute plasma is superior to normal or concentrated plasma in the treatment and prevention of shock in dogs. They further considered dilute plasma more logical for plasma volume replacement in traumatic shock because the fluid lost at the site of trauma contained a concentration of proteins comparable to dilute plasma, namely 3 to 4 Gm. per 100 c.c. This concept fails to take into account two important considerations. First, the fate in the body of the saline fraction of dilute plasma when given intravenously; and second, the abnormal distribution of fluids in the body during shock, with particular reference to the increase in the tissue fluid at the expense of the circulating volume. These considerations can be partly clarified by reference to the data of these authors.[55] For example, dog 40-202 received 700 c.c. of dilute plasma with an average protein concentration of 3.5 Gm. per 100 c.c. On this basis 24.5 Gm. of protein were injected. According

to table III of the same article, the plasma volume of this animal decreased 235 c.c. during shock. After the 700 c.c. of dilute plasma with 24.5 Gm. of protein were given the volume increased only 380 c.c. This increase in volume represents only one-half of that expected had all of the injected fluid been retained in the circulation. One must conclude that the saline fraction was lost in the tissues and the blood volume increase was related strictly to the amount of protein given.* This analysis is given to emphasize once more that normal plasma tends to remain in the circulation volume for volume; concentrated plasma increases the plasma volume until it reaches the normal protein concentration for that subject, while the dilute plasma volume diminishes in the circulation until the protein concentration is normal for that subject. Of these three different solutions of plasma proteins, concentrated plasma alone tends to influence favorably the abnormal increase of fluids in the tissues. Conversely, dilute plasma would tend to further accentuate the already present pathologic distribution of fluid in shock.

In evaluating the effectiveness of plasma protein solutions of different concentrations, it would seem that comparison should be made on the basis of (a) the volume of the solution and (b) the total protein content given. No such comparison bases were considered by these authors[55]. The experiment of dog 41-15, which received concentrated plasma therapeutically, demonstrates this point. While the protein concentration of the plasma was not stated, it is unlikely that it exceeded 20 Gm. per 100 c.c., if a protein concentration of 5.0 Gm. per 100 c.c. was present in the citrated plasma prior to desiccation.** In our experience we have found that the protein concentration frequently falls below the 20 Gm. per 100 c.c. level, being frequently between 15 and 20 Gm. per cent. On this basis, 50 c.c. of such plasma would contain between 7.5 and 10.00 Gm. of protein. The calculated blood volume increase would be between 100 and 150 c.c., which could only be expected to produce the mild transient results observed. Therefore, the value of comparing 24.5 Gm. of protein in one solution to 7.5 to 10.0 Gm. in another is questionable. Furthermore, in these experiments it was stated that in an occasional dog receiving concentrated plasma the

*The plasma protein concentration during shock (5.1 Gm. per 100 c.c.) and after treatment (5.06 Gm.) in this experiment remained about the same. This means that the expected plasma volume increase can be determined by the ratio of the injected protein and the animal's plasma protein concentration (24.5/5.1 or 480 c.c.) The actual increase was 380 c.c. and the amount lost was 320 c.c.

**The dogs had a normal plasma protein concentration of approximately 6.5 Gm. per 100 c.c. If 70 c.c. of a solution of sodium citrate were used as anticoagulant for every 500 c.c. of blood collected from similar donor dogs and the net plasma yield was 50 per cent, then each 320 c.c. of citrated plasma contained a protein concentration of 5.0 Gm. per 100 c.c., as obtained by $(6.5 \times 2.5) \div 3.2$.

volume remained essentially unchanged but in spite of this the blood pressure fell and the animal died. Such may result from the presence of an excess of citrate or barbiturate in the plasma as discussed elsewhere[21].

Dehydration is sometimes used as an argument against the use of concentrated plasma. This reasoning has resulted from the observation that other concentrated solutions, such as 50 per cent glucose[57], are dehydrating in nature. Concentrated glucose and concentrated plasma are quite different in their actions. When concentrated glucose is given intravenously it draws water from the tissues into the blood stream, following which the glucose tends to be taken up by the liver or metabolized. The plasma volume is increased at the expense of diluting the normal constituents in the plasma. The kidneys, being more concerned with the composition[58] rather than the volume of the plasma, expel the extra water by tubular rejection. Such a mechanism is known to be dehydrating in normal subjects. Concentrated plasma, on the other hand, draws water from the tissues but because of its composition, the increased plasma volume retains a make up similar to normal plasma. Again the kidneys being more concerned with composition, rather than volume, does not discard the added fluid. In this same connection the question of how concentrated plasma produces diuresis in hypoproteinemic edema will be asked. As mentioned above it does this by encouraging the renal plasma flow when the salt intake is restricted.

It has been stated that reactions are more frequent when concentrated plasma is given. If a reaction-causing substance be present in the plasma originally, this statement of course is true. By our methods of preparation the concentrate is innocuous as shown by a febrile reaction rate below 1 per cent[20]. The recent report of Polayes and Squillace[59] emphasizes the ever present danger of agglutination reactions when the pooling of plasma alone is relied upon to suppress these and other related antibodies. Our technic of pooling all types of whole blood is a better check against such reactions. The presence of hemoglobin or human globulin in protein solution does not cause reactions. Pyrogenic substances and bacteria must naturally be excluded before other causes of reactions are considered. It is difficult for us to understand why it is implied that concentrated plasma causes reactions when after the administration of over 100,000 c.c. under our control our reaction rate continues below 1 per cent.

The only significant contraindication to the use of concentrated plasma is the presence of incapacitating myocardial damage. If

such be absent, the concentrate can be used very effectively in the handling of hypoproteinemic edema, saline edema and for intravenous protein feeding.

Dunphy and Gibson[24] have emphasized a very important point in connection with shock therapy, that is, the earlier the shock, the less the therapeutic dose of plasma required and the more prompt the response; therefore, the way to prevent late or fatal shock is to treat it early when it is most amenable to therapy. Such early treatment, particularly under combat conditions, can be realized when concentrated plasma is adopted and the maximum advantages of speed, simplicity of administration and therapeutic effectiveness are thus made available.

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WOUNDS OF THE HEART

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THE subject of wounds of the heart should be of general interest to the medical profession for such a calamity requires prompt diagnosis, rapid and intelligent surgical management. Although the incidence is rare, the occasion is usually unexpected. With certain fundamentals of pathologic physiology and surgical technic in mind, the man of average surgical training should be competent to handle such a case.

The first suture of the human heart was recorded by Cappelen in 1895. This was a case of a twenty-four year old man with a stab wound of the left ventricle and a severed branch of the coronary artery. He was successfully operated upon under chloroform anesthesia and survived for two and one-half days, dying of anemia and pericarditis. The wound, however, had not penetrated into the cavity of the left ventricle. The bleeding had occurred from the coronary artery. The second attempt was by Farina of Rome in March, 1896. His patient, a thirty year old man, had received a stab wound of the heart with cardiac tamponade.* The laceration was successfully sutured, the patient dying on the fifth postoperative day of bronchopneumonia. The third case was reported by Rehn of Frankfort on Sept. 9, 1896. Rehn's case was that of a twenty-two year old man who was stabbed in the fourth interspace with a knife, two finger-breadths to the left of the sternal margin. After a period of unconsciousness which lasted three hours, the patient revived sufficiently to take about 300 paces before he fell to the ground. The patient regained consciousness and was taken to a hospital. On the second day signs of extreme circulatory failure with cyanosis and marked dyspnea developed, and operation was performed. An incision, 14 cm. long, was made in the fourth left interspace and the fifth rib divided in the mammary line. The pleura was opened. Blood distended the pericardium and oozed from the stab wound which entered it. The pericardium was opened widely and the blood within it was removed. The wound, 1.5 cm. long, was found in the right ventricle, from which there was active bleeding. This was controlled by placing a finger over the wound, but difficulty was experienced in keeping the finger properly placed. There was less bleeding during diastole than during systole. The wound was closed with three silk sutures placed during several diastolic phases.

*Cardiac tamponade is used to denote compression of the heart by blood within the pericardial sac.

NOTE: Space requirements have necessitated abridgment of the review of literature.—EDITOR.

The pulse immediately improved. After the blood was removed from the pleural and pericardial cavities, an iodoform gauze drain was placed in each. The patient recovered and was able to return to work. This case was supposed to have been the first successful suturing of a stab wound of the heart.

From this time there appeared in the literature increasing numbers of cases of successful suture of penetrating wounds of the heart. In February, 1939, Bigger reported a collection of cases of wounds of the heart treated surgically. There were 428 such cases until January, 1932, with only 55 of them from this country. In a widespread inquiry to 427 surgeons Bigger was able to collect 140 such cases of patient operated upon by 47 surgeons in this country. Fisher, in 1868, estimated the mortality of 452 cases of untreated heart wounds to be 90 per cent. In 1909 Peck collected sixty cases treated surgically with 36.87 per cent recovery. Bigger estimates the recovery of patients with wounds of the heart surgically treated to be between 50 and 60 per cent. With these figures in mind one is immediately struck with the value of surgical treatment in this condition.

Surgical Considerations

Unfortunately, all wounds of the heart do not lend themselves to surgical treatment as the death of the patient is so rapid that frequently they do not reach the hospital alive. Wounds of the heart which lend themselves to surgical intervention are restricted to injuries inflicted by an instrument that will not cause large wounds of the cardiac wall. The majority of wounds of the heart which can be treated surgically are inflicted by knives, ice picks or firearms of small caliber, the traditional instrument of infliction being the so-called "switch blade" knife which is so dexterously handled by darkies in their Saturday night altercations. By far the most frequent site of wounds of the heart is in the right ventricle as this portion of the heart is situated most superficially. Fortunately, this site is the one of easiest surgical accessibility. Wounds of the left ventricle, intra-ventricular septum, conus arteriosus, the right and left auricle, the great vessels and the coronary arteries and veins do occur and have been repaired successfully.

Pathologic Physiology

The pathologic physiology of penetrating wounds of the heart is well understood and has been clearly described by numerous authors. Following a stab wound of the chest wall penetrating the pericardium and chamber of the heart or severing a coronary vessel, there occurs a moderate amount of bleeding from the soft tis-

sues of the chest and perhaps some escape of blood from the wound in the pericardium. However, in most cases this is negligible and does not begin to account for the rapid development of the signs and symptoms that ensue. The wound of entrance is usually small and does not allow much escape of blood from the pericardial sac. In the event of a wound penetrating the cardiac wall with penetration of one of its chambers, there ensues a forceful gush of blood from the wound with each systolic contraction of the heart. This forceful expulsion of blood into a fairly non-elastic sac, the pericardium, results in a rapid accumulation of blood within the pericardial sac with encroachment on the space allowed for the diastole of the heart and on the venae cavae, the result being that the venous return is rapidly and progressively curtailed. Since the pressure in the thoracic portion of the venae cavae is negligible, the increase of intrapericardial pressure due to rapid accumulation of blood abruptly stops the venous return to the heart. The intrapericardial pressure must be overcome by an ever increasing compensatory rise of venous pressure in order to maintain a return flow of blood to the heart. This compensatory mechanism carries on until the venous and arterial pressures become equal, at which time the heart is arrested. This latter mechanism, together with the possible escape of small quantities of blood through the external wound, accounts for the prolongation of life in many such instances. With this impairment of circulation there occurs anemia of the brain and a rapid congestion of the veins, as seen most prominently in the cervical veins. In numerous wounds of the heart there is the accompanying wound of the pleura communicating with the pericardial wound, in which case rapid bleeding into the adjacent pleural sac ensues, making for a more speedy death from hemorrhage. However, such an escape valve in these wounds, if of small size, may often act as a life-saving device. In the event of severance of the coronary vessels or great vessels, the same mechanism of cardiac tamponade holds true. With these few basic principles in mind one readily understands that the surgical problem involved is threefold, namely (1) pericardiotomy with the release of cardiac tamponade, (2) closure of the wound and hemostasis, and (3) the general principle of the prevention of infection.

History Obtained from Patient

The history obtained from a patient suffering from a stab wound of the heart is in many instances worthless. In those patients in whom the state of consciousness is such that they may relate a history, one frequently receives the information that the patient was stabbed in the precordial region of the chest but oftentimes in

the posterior or lateral chest, or that the bullet wound was received in these areas. The patient may state that following the infliction of this wound, he pursued his assailant a few paces and fell to the ground because of weakness, vertigo, unconsciousness or marked dyspnea. There is usually a history of only a moderate loss of blood. The patient may be able to rally somewhat after the initial onset of unconsciousness or severe weakness and present himself in only a moderate degree of shock. Too frequently the patient is unconscious or in such a state of shock or inebriation that no history is obtainable.

Physical Examination

The physical findings in such a case are fortunately of enough clarity to warrant prompt diagnosis or to stimulate enough suspicion to justify exploration. The patient may be in a state of unconsciousness or, at the other extreme, may appear only in mild shock. The skin is pale, moist and cold with a moderate cyanosis of the lips and mucous membranes due to increased venous pressure. The veins of the neck are characteristically markedly distended and beaded, and there may be distention of other peripheral veins. The pulse may be weak, thready, irregular and oftentimes imperceptible. The blood pressure is characteristically lowered and frequently cannot be determined. The venous pressure, which normally varies from 80 to 120 millimeters of water, is increased because of intrapericardial pressure and has been recorded in some cases as high as 400 millimeters of water. Usually no enlargement of the heart can be made out from percussion. Heart sounds are weak and often not audible, but when heard, the heart rate is rapid and there may be irregularities. The apex beat may not be seen and there is no visible or palpable evidence of cardiac activity. Examination of the lungs varies, depending on the presence of a communication with the pleura. In cases in which the pericardium communicates with the pleura where there is an accompanying hemopneumothorax, air may escape from the pleural sac into the pericardial sac, and one may hear a churning, slapping sound as described by Bigger in such a case in his series. The roentgenologic examination shows no appreciable enlargement of the cardiac shadow in early cases as the pericardium expands only with long standing, slowly increasing pressure. *This fact should be stressed for many people believe that a negative roentgenogram excludes tamponade.* On fluoroscopic examination one finds a "quiet heart" with little or no visible cardiac activity, hence a definite diagnosis of cardiac tamponade can be made on fluoroscopy. Aspiration of the pericardium may be of diagnostic aid in doubtful cases.

Treatment

Preliminary.—The treatment of wounds of the heart may be divided into preliminary treatment and operation. The preliminary treatment is very well described by Bigger, from whom I quote:

> When the patient is admitted with signs and symptoms suggesting a wound of the heart, he is placed in moderate Trendelenburg position, given morphine and atropine and if in profound collapse, is given 5 minims of adrenalin hydrochloride hypodermically, and 10 to 15 minims of adrenalin are added to the venoclysis fluid which is administered slowly. Blood pressure is taken frequently. The general appearance is carefully noted, and the superficial cervical veins are carefully inspected. The latter observation should be made with the patient in the horizontal position. The thorax is examined and an attempt is made to discover whether there is a pneumothorax, hemothorax or a combination of the two. The cardiac area is carefully percussed and auscultated. In two instances in which there was free communication with the left pleural cavity, there was noted a characteristic splashing or churning sound with each heart beat. If this sign is present in association with massive hemorrhage, immediate operation is indicated; but if there is only a small amount of blood in the pleural cavity and there are no signs of tamponade, conservative treatment is continued. If there are signs of cardiac tamponade and the blood pressure does not rise to shock level, the patient is operated upon without further delay. If there is any doubt as to the diagnosis and the patient's condition is not too serious, further studies are made, especially frequent determinations of the arterial and venous pressures and fluoroscopy. The diagnosis of tamponade can be made with certainty by the use of the fluoroscope. This in connection with the arterial and venous pressure determinations will give an accurate idea of the degree of tamponade. In the past we have been inclined to operate upon all patients with signs of tamponade or with signs of cardiac injury and moderate or massive intrapleural hemorrhage. As a result of our experience and in view of the literature, we now believe that patients with heart wounds should be operated upon promptly if indications are clear and urgent, but if indications are not urgent, some form of conservative treatment should be considered. For purposes of study we suggest that patients with wounds of the heart be divided into four groups, the plan somewhat similar to that recommended by Maier (Surgery, Gynecology and Obstetrics, 1936). Patients with evidence of cardiac injury but without tamponade or massive intrapleural hemorrhage are placed in Group 1. Patients with tamponade but who show satisfactory response to conservative measures with the return of the arterial pressure to near normal are placed in Group 2, while those who do not show a satisfactory response with a persistent low blood pressure are placed in Group 3. Patients with penetrating wounds of the heart with bleeding into the pleura constitute Group 4.

Operation.—After a period of preliminary treatment for shock, which obviously should not be of too long duration, operation should be performed and done with the same aseptic technic as is used in any operation. The chest should be prepared as for any other operation, painted with antiseptics and sterile drapes applied, the choice of anesthesia depending upon the patient's condition. Frequently the patient is in such moribund condition that no anesthesia

is required until the patient regains consciousness following the release of the cardiac tamponade. Frequently the operation may be carried out under local infiltration. Sometimes the operation can be begun with local infiltration supplemented with general anesthesia as the patient's condition improves after the tamponade is released. Not infrequently operation can be carried out with general anesthesia throughout if the patient's condition so warrants. Elkin advises, in emergency surgery of the heart, the use of general anesthesia in preference to local anesthesia because the pleura may have been opened by the wound or may be accidentally opened during the operation, and nitrous oxide and oxygen under positive pressure is necessary for the inflation of the lungs. Difficulties of heart suture require that the patient be quiet, but these patients are usually wildly excited or apt to become so with the release of the tamponade, and unless they are completely anesthetized, their struggles may interfere with the operation at the most inopportune time.

Numerous operative approaches to the heart have been devised. Cutler favors the median sterniotomy, in which the sternum is split longitudinally with a saw or bone shear to the level of the second or third intercostal space, where it is cut across. The sternum is retracted and the pleura dissected laterally with a moist sponge. The peritoneum is opened and the anterior portion of the diaphragm is incised. The pericardium is opened widely, the incision extending to its reflection on the diaphragm. Exposure of the entire heart is obtained by this method.

Spongaro favors the intercostochondral thoracotomy. For this exposure an incision is made in the fourth intercostal space on the left, extending from the anterior axillary line to the sternum where it is continued in each direction along the margin of the sternum to expose the third, fourth, fifth and sixth costal cartilages. These costal cartilages are sectioned. The internal mammary vessels are ligated, and the incision is extended through the underlying muscles into the pleura. The structures are retracted and the pericardium is opened. The left lung, the left ventricle and part of the right ventricle are exposed. Part of the right ventricle and the base of the heart, including the auricles, are not exposed. The transverse sinus and vena cava are not accessible. Control of hemorrhage by compression of these structures therefore cannot be carried out when this exposure is used. The exposure, however, will permit direct compression of the ventricles in the hands of the operator. To increase the exposure of the heart, it has been suggested that the second costal cartilage be divided and that the sternum be split transversely. If the wound lies in the fifth interspace, the costal

incision should be placed in the fifth, rather than in the fourth, interspace. This method has the advantage in that exposure of the left pleural cavity is obtained. This is the method of preference in those cases with a wound in the left lung from which there is active bleeding. In the absence of a wound of the left pleura this incision has the disadvantage of opening the pleural cavity.

Elkin recommends two exposures. In the first a transverse incision is made across the soft tissue overlying the sternum at the level of the fourth or fifth intercostal space, depending on the site of the wound of entrance. The soft tissue is retracted upward and downward, exposing the underlying costal cartilages and sternum which offer easy accessibility to resection as needed. This wound has the advantage of being enlarged with ease. The second incision consists of turning a musculocutaneous flap laterally by a curved incision over the suspected area and removing two or more costal cartilages and ribs as required.

Bigger favors the so-called "hockey-stick" incision, consisting of a parasternal incision from the lower border of the third rib, somewhat outward to the upper border of the sixth rib and thence laterally along the course of the sixth rib. The skin, subcutaneous tissue and muscle are dissected free from the thoracic wall and retracted laterally, exposing the underlying rib and costal cartilages and lateral border of the sternum. The necessary costal cartilages distal segments of the ribs and, if necessary, the lateral portion of the sternum, are easily accessible for resection. This incision offers excellent exposure and has the advantage that it may be placed on either side of the sternum, depending on the site of the wound.

After exposure of the pericardium in any of these methods, it is necessary to clamp and ligate all vessels, paying particular attention to the internal mammary vessels to prevent subsequent hemorrhage following operation. Whenever the time element permits, care should be taken to dissect the pleural reflection from the pericardium before opening the latter sac. After the pericardium is exposed, the wound of the pericardium gives the surgeon an idea as to the portion of the heart most likely to be involved, and the necessary ribs, costal cartilages and segment of the sternum can be resected accordingly. The pericardium is then opened widely over the selected site, the pericardial sac aspirated and the site of bleeding located as quickly as possible. Frequently in wounds of the right ventricle and of the left anterior portion of the left ventricle or of the coronary vessels in these areas, bleeding can be controlled by pressure with the tip of the left index finger over the site of bleeding. With the tip of the left index finger held over this site, sutures

may be placed in the myocardium beneath the finger in these areas and tied by the assistant. Care should be taken in so placing these sutures that they do not penetrate the endocardial lining of the heart chamber and that they are not tied so tightly as to strangulate the myocardium. In large lacerations of the cardiac wall one may place sutures in the myocardium lateral to the wound with the left index finger over the opening to prevent further hemorrhage. After placing the lateral suture on either side, these are crossed over and held by the assistant, thus bringing the wound together and causing the cessation of bleeding. Following this the operator may leisurely place his sutures for approximation, and after these sutures are tied the lateral traction sutures may be withdrawn. However, in wounds of the base of the heart, posterior surface of the auricles or great vessels, the accessibility for suture is difficult to obtain. In such cases the apex traction suture described by Beck in 1926 is oftimes a lifesaving procedure. This consists of a fine silk suture placed through the myocardium at the apex of the heart. This suture is held between the thumb and fourth or fifth finger of the left hand while the left index finger is placed over the heart wound. By this method the heart can be retracted upward, exposing the posterior surface, and may be retracted downward, bringing the base of the heart into a more accessible position for suture. This traction suture is especially helpful in bullet wounds of the heart as there are usually two wounds, one of entrance and one of exit.

After hemostasis has been accomplished and repair of the cardiac wound has been done, all blood should be carefully aspirated from the pericardial sac and the pericardium thoroughly irrigated with normal saline solution. In the event that the pleura has been opened, it is also equally important that all blood be aspirated from the pleural sac. It is oftimes helpful in aspirating the blood from the pleural sac to tilt the head of the table downward, allowing the blood to accumulate in the apical region where it is accessible to the suction tip. One is frequently able to collect a considerable amount of the blood lost by aspiration into a sterile flask containing citrate solution, and this can be administered to the patient intravenously during the remainder of the operation to combat the anemia and shock resulting from such a rapid loss of blood. These patients should, if possible, be typed and matched and blood drawn from donors for intravenous administration after release of the pericardial tamponade. The pericardium should be closed loosely with interrupted sutures to allow intrapericardial collection of serum to escape into the soft tissues. In the event that the pleura has been incised, a careful attempt should be made to close the opening. Collapse of the lung, in the event of opening of the pleura, can be

successfully combated by the use of inhalation anesthesia under pressure. The muscles and subcutaneous tissue are then approximated loosely with interrupted sutures and the overlying skin closed tightly. Drainage of the pericardium and of the wound of the soft tissue should be avoided whenever possible. Should it be felt that drainage is necessary, a drain should be left in place for only a very short while as infection may be introduced along the course of the drain. The subsequent collection of fluid in the pericardial sac following operation can be successfully aspirated with a needle as in any other case of pericardial effusion. If the fluid cannot be withdrawn in this manner, a secondary pericardiotomy should be done.

Postoperative Treatment and Complications

The postoperative treatment of these cases should consist of absolute rest in bed with adequate quantities of morphine to relieve pain, and the patient should preferably be placed in an oxygen tent as an aid to both the circulatory and respiratory mechanisms. All stimulants are to be avoided whenever possible. Anemia should be combated immediately by repeated small transfusions of from 250 to 350 c.c. of blood, preferably by the citrate method, at a very slow rate so as not to cause an increase in the blood pressure. The blood count should promptly be restored to normal by transfusions before the period of softening of the wound occurs. Bigger recommends that the patient should remain at absolute bed rest from two to three weeks and that a period of six weeks to three months should elapse before the patient should resume his normal routine of life.

The postoperative complications are chiefly those due to blood loss with shock and anemia resulting; those due to infection, namely, pericarditis, mediastinitis and empyema in the event that the pleura has been opened. Secondary cardiac tamponade may occur because of subsequent hemorrhage or pericardial effusion and may be handled by aspiration or pericardiotomy if indicated. A certain amount of pericardial effusion is reported by Beck to occur following any handling of the pericardium or heart but usually in these cases is of no serious significance. Cardiac infarction due to ligation of the coronary vessels does occur and should be handled as in any other case of coronary occlusion. Usually, however, wounds of the heart occur in young individuals, and the myocardial circulation is much more abundant than in the other individuals who are subject to myocardial infarction from occlusion of diseased coronary vessels. Mural thrombi unquestionably occur in many of these wounds which penetrate into the chambers of the heart, and emboli

are undoubtedly thrown off from time to time. However, in only one of a large series of cases reported was there massive pulmonary embolism of serious consequence. Bronchopneumonia and other pulmonary complications may follow such an operation as in the case of any other operative procedure and should be treated accordingly.

The chances for recovery of patients with wounds of the heart treated surgically are said to be from 50 to 73 per cent. In wounds involving or penetrating the right ventricle, with successful suture the chances for recovery are estimated at 80 per cent.

A large series of cases was followed by Bigger over a period of years, and in all of such patients surviving he was unable to demonstrate any cardiac impairment on physical examination, roentgenologic examination or electrocardiography. Beck has shown experimentally with dogs that pericardial and cardiac operative procedures are followed by numerous adhesions between the pericardium and epicardium. However, these adhesions do not occur to such an extent as to impair the cardiac action.

Report of Cases

Case 1.—A thirty-one year old white woman was admitted to the hospital at 9:05 p. m. on March 23, 1940, a few minutes after having been stabbed in the left anterior part of the chest with a knife. The patient became rapidly and progressively weaker and was rushed to the hospital immediately following the stabbing. She was in a state of shock, and an adequate history could not be obtained. She complained of precordial pain, weakness, dizziness, dyspnea and sense of impending death.

The skin was waxy, white, cold and clammy. The lips were cyanotic and the neck veins markedly distended. Peripheral pulsation could not be elicited, nor could the blood pressure be taken. There was a small linear stab wound, 2 cm. in length, in the fourth left intercostal space, approximately 2 cm. inside the mid clavicular line. The apex beat could not be seen or felt, nor could the heart sounds be heard. The patient was given 1 c.c. of coramine and fluoroscopy was done; this revealed no apparent enlargement or distention of the pericardial sac. However, no movement of the heart was seen. The lungs were clear with normal expansion of the diaphragm.

The patient was taken to the operating room immediately. The chest was prepared in the usual manner and the operation begun under local infiltration with 1 per cent procaine solution. A "hockey-stick" incision was made on the left chest, extending from the lower border of the third rib to the upper border of the sixth rib. The segments of the third, fourth and fifth ribs were resected, revealing the pericardium to be blue in color and considerably distended with a small linear perforation from which a small amount of blood exuded. On opening the pericardium a considerable amount of blood gushed forth. The pericardium was aspirated and the source of bleeding found to be from a linear incision of the upper portion of the right ventricle, approximately 2.5 cm. in length, located 2 cm. above the anterior coronary sulcus just above the site

of origin of the anterior descending branch of the right coronary artery. No injury of the coronary vessels was found. By means of a silk apex traction suture the heart was steadied while the perforation was closed with interrupted silk sutures with the tip of the index finger placed over the opening to prevent bleeding during the placing of the sutures. Satisfactory hemostasis was obtained. The pericardium was flushed with normal saline solution and closed

Fig. 1. The first patient a few days after operation.

loosely with silk sutures. During the procedure, the left pleural sac was inadvertently opened; following this the patient was anesthetized with nitrous oxide and oxygen under pressure, which prevented the collapse of the left lung. The pleura was aspirated and closed with interrupted silk sutures. The thoracic wall was closed with interrupted silk sutures and with clips for the skin.

Immediately following operation the patient was placed in an oxygen tent with the head lowered, external heat was applied, and 500 c.c. of citrated blood was given. Following the blood transfusion the patient's condition was considerably improved, the blood pressure having risen to 120 systolic and 70 diastolic. The patient's convalescence was satisfactory. Repeated roentgenologic examinations of the heart revealed an increasing distention of the pericardial sac; this reached its maximal amount in ten days, after which time it subsided gradually, and at the end of three weeks there was little or no enlargement of the cardiac and pericardiac shadow. There was a slight elevation

of temperature for the first ten days, and this was attributed to a moderate amount of blood in the left pleural sac, which was absorbed gradually. The patient was kept in bed for a period of twenty-one days and was discharged from the hospital in good condition on her twenty-sixth postoperative day. On repeated examinations at frequent intervals the patient's progress was found to be satisfactory. She was last seen on May 25, 1940, at which time she was in good condition and asymptomatic and stated that she was able to take her usual amount of exercise without any untoward symptoms.

CASE 2.—An eighteen year old white boy was admitted to the hospital at 2:00 a. m. on April 7, 1940, presenting the unusual history of having been stabbed in the anterior part of the chest with a knife at 12:00 noon on April 6, 1940, fourteen hours prior to admission. The patient stated that shortly after the stabbing, which was done with a "frog sticker blade" of a pocket knife, he noticed rapidly progressive weakness and lapsed into unconsciousness. From witnesses present it was learned that the patient was unconscious for approximately one hour after the stabbing and was taken to the office of his local physician where fluids were administered intravenously and the external wound sutured. There had been only a moderate amount of blood lost. The patient revived shortly after receiving fluids intravenously and was taken to a town some miles distant where a roentgenogram was taken and the patient's family advised to bring the patient to this hospital as, according to the parents, "a heart operation might be necessary." The patient stated that since being revived from his initial period of unconsciousness, he had remained conscious but had been moderately dyspneic, had felt weak and dizzy, had been extremely nauseated and had vomited everything taken by mouth. He had noticed marked thirst. There had been no further bleeding of the external wound after suture.

Examination revealed a well developed and well nourished white boy, conscious, rational and cooperative but complaining of nausea and dyspnea. The skin was pale, moist and cold. The lips were pallid with a moderate degree of cyanosis. The mucous membranes were moderately pale. The veins of the neck were markedly engorged. Blood pressure was 90 systolic and 60 diastolic. Venous pressure was 250 millimeters of water. Pulse rate was regular, of fair volume but rapid—120 per minute. There was a recently sutured linear wound, approximately 4 cm. in length, in the fourth left intercostal space 5 cm. within the mid clavicular line. The apex impulse of the heart could not be felt or seen. Heart sounds could be faintly heard but were not irregular or of abnormal quality. Fluoroscopic examination revealed an appreciably large "water-bottle" heart with no visible pulsations other than the faint movement at the base. The lung fields were clear.

The patient's condition was good and no preliminary preparation was needed other than the usual preoperative morphine and atropine. Under nitrous oxide and oxygen anesthesia, using pressure by the closed mask method, the chest was prepared and a left "hockey-stick" incision made from the upper border of the third rib to the upper border of the sixth rib and the incision extended laterally along the course of the sixth rib. All bleeding points were clamped and ligated with fine silk ligatures. The costal cartilages and distal 3 centimeters of the third, fourth and fifth ribs were resected, exposing the underlying pericardium and left pleural reflection. During resection of the third rib, the left parietal pleura was inadvertently opened. The perforation of the pleura was located, being approximately 2.5 cm. in length, and was closed with three interrupted silk sutures. A large linear laceration of the anterior

pericardium, about 2.5 cm. in length, was found 2 cm. lateral to the sternal attachment of the fourth costal cartilage, from which a moderate amount of dark blood exuded. The pericardium was bulging and blue. When the pericardium was opened, a considerable amount of dark blood gushed forth, most of which was aspirated into a flask containing citrate, and the pericardial sac completely aspirated. The patient was given an autotransfusion from

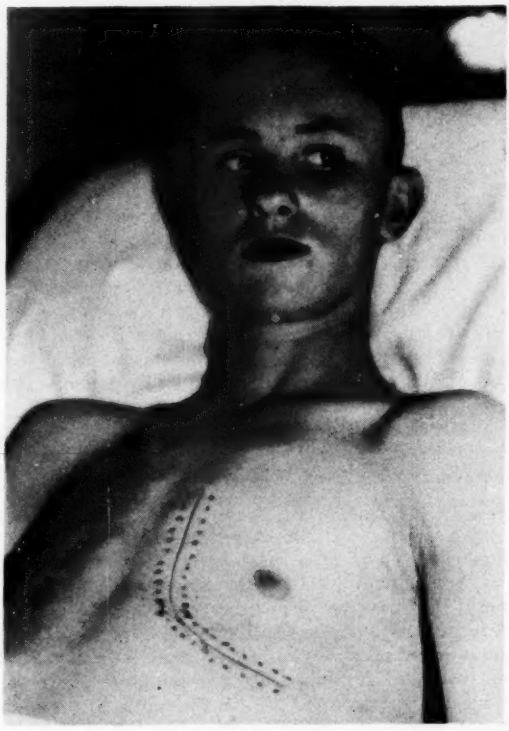

Fig. 2. The second patient at the time of discharge from the hospital.

the pericardial blood. The heart action was regular and not appreciably increased in rate. A linear laceration, 1.5 cm. in length, was found 1.5 cm. above the apex, penetrating the anterior wall and extending into the chamber of the right ventricle. A small clot was found over this laceration, which was not bleeding when first found. However, bleeding promptly ensued. The tip of the index finger of the left hand was placed over the perforation to control bleeding, and a suture of fine silk was passed through the myocardium at the mid portion of the laceration beneath the finger. This suture adequately controlled the bleeding. However, in passing the suture, the needle punctured a small branch of the anterior descending coronary vessel, and it was necessary to place four similar sutures and one superficial mattress suture through this region to control the bleeding vessel. Following this, complete hemostasis was obtained, and the cardiac action appeared unimpaired. The pericardial sac was irrigated with normal saline solution and the pericardium closed loosely with interrupted silk sutures. All bleeding points were ligated with fine silk liga-

tures, the muscle and subcutaneous tissue approximated with interrupted silk sutures and the skin closed with clips.

Following operation the patient was placed in an oxygen tent and received morphine for the relief of pain. His blood count was restored to normal by two small transfusions on his first and second postoperative days. Convalescence was uneventful, the patient running a course similar to that of case 1 with a slight elevation of temperature for ten to twelve days postoperatively and roentgenologic evidence of progressive enlargement of the pericardial shadow, which began to subside after the second week. At the time of discharge from the hospital on May 3, 1940, the pericardial shadow was normal in size. The patient was seen on May 26, 1940 (7 weeks after the accident), at which time he stated that he had been asymptomatic and had confined his activities to being up and about his home and to taking short walks around the yard. He stated that he felt fine and had had no dyspnea or signs of circulatory embarrassment. Physical examination at this time revealed no abnormalities of the heart or lungs.

SUMMARY

1. A summary of history and incidence of the surgery of heart wounds has been presented.

2. A discussion of the types of wounds encountered in trauma of the heart, with the findings and their evaluation has been presented.

3. The diagnosis of cardiac wounds, stressing fluoroscopy and venous pressure determination as diagnostic aids has been presented.

4. The treatment of wounds of the heart is fully discussed including the management of the preoperative and postoperative course and complications.

5. Reports of two cases of stab wounds of the right ventricle which were treated by the author are presented.

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THE PART THE RAILROAD SURGEON MAY PLAY IN THE NATIONAL EMERGENCY

War came to the United States suddenly and treacherously on December 7. On December 10 the War Department issued Communique No. 2 which said in part:

Steps to augment the defenses of both the East and West coasts commenced Sunday night when the War Department placed plans in effect which have materially strengthened the forces already stationed in those areas. *The railroads aided greatly in the movement of troops and material, operating through trains to destinations on emergency schedules.*

Thus, the many years of planning and preparation proved their worth in the nation's hour of need. Too, the years of planning and preparation will enable the American railroads to keep on aiding greatly—and proudly—in the tremendous victory effort to which the nation is now dedicated.

The railways of the United States are the most efficient in the world. Now, as never before, they must be kept efficient, because the transportation which they provide is an integral part of our war effort. They have clearly demonstrated their ability to meet the unusual demands made upon them. In 1941 they produced more transportation than in any year in their amazing history. The number of tons of freight carried one mile approximated 459 billions. This was an increase of about 3 per cent over the previous all time record established in 1929. In 1941 partly owing to troop movements, passenger business increased to about 29 billion passenger miles, or 22 per cent over 1940. The record of troop move-

Read before the thirteenth annual Postgraduate Surgical Assembly of The Southeastern Surgical Congress, Atlanta, March 9, 10 and 11, 1942.

ments alone is notable. During the first ten months of 1941 it, at times, exceeded that of 1918. For instance, in the first ten months of last year, our railways carried more than 2,200,000 soldiers, sailors, marines and selectees. After the declaration of war with Japan in December, that total was of course materially increased.

The record for last year is impressive but it will be surpassed. The job ahead will call for more stupendous tasks than ever. The 150 billion dollar defense program means the dependable movement of raw materials and finished products in an ever increasing tempo. It means the rapid movement of troops and their equipment. In short, it means transportation of the highest order, and that is what our railways must provide. I am not unmindful of the part that other transportation agencies will play in the set-up, but it must not be forgotten that the railways still handle about two thirds of our nation's total freight traffic.

Behind all the cars and locomotives and glistening rails and other equipment and facilities comprising the vast railway systems of our country, stand the men who operate them. The Class 1 railways of the United States, excluding switching and terminal companies, had slightly more than 1,184,500 employees in December, 1941. This represents an increase of a little more than 15 per cent compared with the same month of the previous year. It is reasonable to assume that more men will be needed and employed. They must be good men, for theirs is an important job. It is essential that they and the great force of employees now carrying on, be kept in the highest state of efficiency. It is imperative that they be kept on the job so that the wheels of transportation may be kept rolling.

The selection of employees who are physically fit and the safeguarding of their health and the treatment and rehabilitation of injured employees is the direct responsibility of the railroad surgeons. To perform this service the railroads have an army of surgeons totalling 16,188 and one and all they stand ready to give their best to our country in its emergency. No authorization has been given to me to make such a statement, nor is it necessary for me to ask for such authorization, since such might question the patriotic motivation which we all know is in the minds of the men who serve the railroads and stand ready to serve their country.

To us it may sound trite to say that the railroad surgeons are especially equipped to give the kind of service which the country requires in its emergency, or to state that their special training in traumatic surgery has given them the experience which makes them invaluable for any civilian or other service which they may be called upon to contribute to the country in its time of need.

The railroads have carried on for many years a definite program which has become almost routine in the matter of physical examinations of employees. All applicants for employment in train service are given a thorough physical examination by the railroad surgeon. These physical examinations are no longer in the experimental stage. Standards of physical requirements for entering the service have long been established and are so generally employed that their value is not questioned. The requirements are high and are practically the same as obtained for admittance to the armed services. Satisfactory railroading is founded upon physical fitness, —from the viewpoint of the individual as well as from the viewpoint of the railroad.

A definite idea of the manner in which the railroad surgeons are valuable, or at least equipped, to serve in civilian capacities in time of emergency was presented in an address of Wing Commander G. Edward Hall of the Medical Corps of the Canadian Air Force. This address was given at the 1941 meeting of the Medical and Surgical Section of the Association of American Railroads. He said that railroad surgeons' problems were the same as the problems of the Air Force in that railroad medicine is similar to aviation medicine, both being branches of industrial medicine. He further stated:

> Anything that we may do in the way of devising tests for examination for fitness for these duties, regardless of whether the man is going to fly or be a railroad engineer, is all directed toward the same ultimate purpose,—that is to obtain a man who is mentally and physically fit and then maintain his fitness for the duration of his service. That broad aspect is exactly the same as we divide the work in aviation medicine. There are, then, two purposes: First, selection; and Second, maintenance. In the selection of personnel for the Air Force, the two main divisions are similar to the main divisions in railroad medicine, that is: First, we have air crew, and Second, ground crew. You have train crew and an essentially ground crew or shop crew.

Wing Commander Hall, after outlining the requirements of an air crew, such as perfect muscular balance, a high rating in visual acuity, blood pressure standards, perfect color vision, compliance with weight and similar requirements, declared that on the whole aviation medicine and railroad medicine or surgery are almost the same, the difference being that the specific duties have to be considered in connection with the specific type or standards that are to be set up for members who are going to perform a particular duty. The words of Commander Hall show the availability of railroad surgeons for defense work in the emergency. He places a high value on the experience of railroad surgeons in making physical examinations and says that the objectives in Air Force selections and railroad employee examinations are greatly similar.

It is estimated that it costs a railroad $10,000.00 to train an engineer for satisfactory passenger service,—an investment which makes a long term of service necessary to pay out. The mechanical side of railroading has been greatly improved by rigid systems of inspection, overhauling and repairing. In similar manner human service can be greatly improved and prolonged by frequent physical examinations and proper treatment for physical defects revealed by these examinations. The mechanical departments of our railroads have made phenomenal progress in the discovery of defects before they have caused wrecks. In a similar manner these examinations are for the purpose of discovering disease before it has incapacitated or disqualified; before it makes human wrecks.

Sixty-five of the larger railroads conduct physical examinations of employees at regular intervals,—a routine procedure. At first there was even some opposition to this on the part of the employees themselves because they felt the plan might not contribute to their general welfare. However, as they observed the results,—results which brought out some health problems which could be remedied, which presented an opportunity to detect any defect at an early period when measures could be taken to remedy it and really prolong their years of service, and even prolong their lives, they changed their attitude and now give their best cooperation to such examination. It is obvious that the experience of the railroad surgeons in making examinations and records with regard to the condition of railroad employees and the research they have engaged in in this project highly qualifies them to give the greatest assistance in the emergency which the country is now facing.

The railroads also have a program which is intended to improve the sanitary and health conditions in the territories which they serve. All of which means health building and sanitary development of no mean proportions. It is a matter of common knowledge that in several of the Southern States under the supervision of railroad surgeons and under the direction of the Medical and Surgical Section of the Association of American Railroads, plans were worked out for the stamping out of malaria and other contagions in the territories through which their lines pass.

Railroad surgeons are especially trained to give the most efficient treatment possible to injured employees. For obvious reasons it is necessary to restore these employees to active duty with complete rehabilitation in the shortest possible time. The Medical and Surgical Section of the American Association of Railroads has performed a great service in the research made in connection with the rehabilitation of injured employees. The Fracture Committee of

that organization has contributed much in the way of establishing First Aid methods in the treatment of fractures and in the dissemination of knowledge concerning scientific rehabilitation of fracture patients. Various industrial hazards have been studied and efficient steps have been taken to effect their removal.

Special railroad cars have been outfitted with emergency supplies and equipment to be carried to the scene of wrecks and other major accidents in order that relief may be given the injured within the shortest time. In case of the bombing of cities with the inevitable civilian casualties, these facilities might well be brought into service to augment the organizations already formed for that purpose. Very probably acts of sabotage will be attempted such as the destruction of bridges and trestles or the placing of obstructions on the railroad tracks for the purpose of wrecking troop trains. Some of these attempts may succeed in spite of all the precautions that are being taken to prevent them. In that event the railroad surgeons will be the first to arrive on the scene to render first aid to the injured. Classes in First Aid have long been established in the railroad shops under the direction of the railroad surgeons and undoubtedly these facilities would be invaluable where their services would be needed in emergencies.

Railroad surgeons treat annually some 17,000 employees who suffer injuries which incapacitate them for a period of three days or more. These are injuries of all types. The total number of injuries received in the actual operation of trains is annually a little less than 16,000, the figures given for 1940 being 15,793. Of these injuries, 3,985 were fractures and 311 called for amputations. Classed as bruises, strains, sprains, lacerations and dislocations were 11,497. These were the injuries which the railroad surgeons were called upon to care for.

With the increasing volume of transportation, both passenger and freight, which the railroads will be called upon to furnish, along with the demand for speed and more speed over the already crowded rails, we may anticipate a larger number of accidental injuries to employees during the emergency. These accidents will occur in spite of all the safety appliances and other scientific safeguards which are thrown around these men who are engaged in a very hazardous occupation. The railroad surgeons will exert a superhuman effort to return these men to useful service in the shortest possible time and thus conserve our diminishing supply of man-power.

The injuries received by railroad employees are in the same category as are the injuries which might come to the civilian population

in time of war. It is obvious, therefore, that the railway surgeons by reason of their special training in this respect alone are well fitted to take care of civilian casualties.

The 16,188 railway surgeons in the United States are playing an important part in the unprecedented emergency which faces us. Theirs is an important and essential contribution to the task of winning the war. They may, however, be destined to play an even more important part. They may be called to render a wider service —a service beyond that relating only to the railroads. If and when they are, they will be found well equipped for the task, because by reason of their work with the great transportation systems, they fully appreciate the value of discipline, organization and coordination of effort. They are experienced in the problems of sanitation. They are expert in making physical examinations, and are thoroughly trained in the treatment and rehabilitation of injured men. God grant that our civilians may be spared the shock and destruction of an invasion of our shores, but if disaster befalls, the railway surgeons will give every assistance within their power. Indeed, whether called for duty at home or with the armed forces along our far-flung battle lines, they stand ready and willing to give themselves wholeheartedly and unreservedly to the service of their country.

JOSEPH D. COLLINS, M. D.

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Norfolk

LET THEM LIE!

A Manual of First Aid for Motorists

(Continued from May issue)

EDITORIAL NOTE: At the present time when so many doctors are engaged in giving lectures in First Aid it seems appropriate to publish a paper on this subject so that doctors may have a convenient guide. This paper was prepared by the Committee on Accidents and Industrial Health of the Alabama State Medical Association, Dr. H. Earle Conwell, Chairman. The Committee wishes to express due credit to Dr. Charles S. Venable and the Fracture Committee of the Texas State Medical Association for the privilege of using some of their ideas and technic in presenting these First Aid articles. Credit must also be expressed to Mrs. Margaret Putman, of the Birmingham *Age-Herald,* Birmingham, Alabama. The material and drawings are reprinted by courtesy of the Birmingham *Age-Herald.*

The Editor believes that this article presents in a very practical way many things which have been neglected in the past.

Article 10.

BROKEN ARMS

A simple fracture means that a bone is broken, without any break in the skin, while a compound fracture means that one end of the bone or bones protrude from the skin.

A compound fracture is more serious than a simple fracture, because the bone end, the marrow, the tissues and the muscles are exposed to infection by coming through the skin, clothing and perhaps into the dirt. When the bone is drawn back into the skin it carries the germs which may produce blood poisoning. In presence of compound fracture, treat shock.

Apply a tourniquet for a time if bleeding is severe; use gentle pressure with a bandage if bleeding is slight. Apply a clean, dry handkerchief, but do not bind tightly.

Treat shock.

Then apply a splint as before described.

Transfer quietly to a hospital. No need to rush and create excitement for the patient. Shock kills—the bone can wait.

Splint them where they lie.

Treat shock.

Seek medical aid. The State Highway Patrol can help you.

Article 11.

BROKEN LEG OR THIGH

In case of a broken thigh or leg, shock is severe and sometimes causes death—the broken bone will not kill, shock will.

Simple fracture is a broken bone which does not have a wound opening through the skin. Compound fracture is when the bone sticks through the skin.

The victim of a broken thigh will usually be pale and sweating and will suffer great pain when he tries to move the leg.

A support must be applied while the patient is flat on his back. Keep him

warm. Use anything available for a splint that will reach from the armpit to the end of the foot; branches, newspapers, anything that can be held securely to the body with belts, ties or strips of clothing. There should be another splint down the front of the leg and on the inner side of the leg from the crotch to the foot. Each should be snugly tied on.

Keep him warm and quiet and wait for a conveyance to take him to the hospital. In the absence of an ambulance, a truck will do very well, as the patient can be laid out flat. His leg can thus be held straight and steady—with the head pointing to the slope of the road.

Never cram the patient into a car. It may cause the simple fracture to become a compound one. This happens, you remember, when the bone end sticks out through the skin. Chances for blood poisoning and infection will be greater and shock will be increased.

A broken bone will wait—shock kills.

If the hip is broken, the patient will be unable to raise the thigh or cross the legs. The knee will be rolled outward. Treat shock.

Splint them where they lie. Keep them flat. Bring them to the hospital, lying flat, warm and quiet.

Pain is relieved by splinting and shock is lessened.

Remember—shock causes more deaths than all other results of highway injuries combined.

Let them lie. Treat shock and splint them where they lie.

Article 12.

Dislocated Joints—Shoulder, Elbow and Wrist

A dislocation is where one of the bones forming a joint is out of its normal place. It is more painful than a fracture, and shock is usually greater. You may recognize a dislocation by the fact that any attempt to move that joint will increase pain, motion will be limited, and there is deformity.

If the dislocation is in the shoulder a lump may be felt in the armpit. In this event the patient will be unable to place the hand on the injured side on the opposite shoulder.

Lay him flat, apply a pad between arm and body and bind to the body by means of a tie, belt, or whatever you have handy. This will remove pressure from the muscles.

Do not attempt to pull or jerk the dislocated bone into place, as you may injure the nerves and cause paralysis of the arm or hand.

Remember the damage you may cause—let him lie still.

There may also be fractures of other bones about the joint unknown to you. Remember the damage you may do. Handle him as little as possible.

Lay him flat, place a pad of folded clothing between the arm and chest and gently bind the limb to the body.

Treat shock—splint him where he lies.

Call the doctor.

Article 13.

DISLOCATION OF THE HIP—KNEE AND ANKLE INJURIES

Shock is usually more severe in dislocations of the lower extremities than of the upper.

A dislocation of the hip results in the thigh being held partly flexed (bent) and the knee is flexed, turning in and against the other knee. To attempt straightening is very painful.

Lay him flat on his back or on the uninjured side, leaving the thigh and knee bent in the most comfortable position. Bind the lower limbs together with a belt or something, first placing a couple of folded coats between the knees.

Keep the patient warm, quiet, and give him a drink. Treat shock.

Splint them where they lie.

A knee injury is very common in automobile accidents, but a dislocation of the knee without fracture of some bone making up the knee joint is rare. Let the patient maintain the position least painful to him, place folded coats between the knees, and strap lower extremities together with a belt. Never try to force a bent knee into position. Serious injury may be caused in forcing the big blood vessels and nerves in back of the knee. If possible, apply a splint from armpit to foot, fastening it to the body and both legs.

Shock will be severe—treat shock.

Ankle dislocations usually mean the presence of a fracture, so do not try to manipulate. Splint with whatever is handy from above the knee to the sole of the foot on the outside—from foot sole to above the knee on inside. Keep warm, quiet and treat shock.

Splint them where they lie.

Always notify the State Highway Patrol in case of accident.

Article 14.

IF NECK IS BROKEN—LET THEM LIE

Keep the head straight and hold the chin up. This is the first thing to remember in case of a broken neck.

An injury to the neck bone is one of the most serious of all types and should be treated with caution. Your treatment may result in the patient having a simple broken bone, paralysis, or death.

The neck can be broken by a quick jerk or by being bumped against the top of the car. If the victim complains of pain when the head is moved forward—be careful—regard him as having a possible broken neck. If the arms or legs feel numb or tingly it is probable the spinal cord has been bruised. If the patient can't move the limbs it indicates the cord has probably been severed by being crushed. This happens when one of the vertebrae has been broken and jammed against the spinal cord. Keep the head straight and chin up. The nearer the chin to the chest the more danger of damage to the spinal cord!

Leave them where they lie, place a folded coat or coats under the neck to keep the head straight and the chin up.

If imperative to move him have someone hold his head straight and his chin up. Do not crowd him into an automobile. Do not try to make him sit up—keep him warm, quiet and still until an ambulance or truck arrives to convey him to the hospital. If a truck is used—lay him flat—have something under his neck and keep his chin up.

Treat shock.

Remember the Highway Patrol gives first aid.

Article 15.

SPINAL FRACTURES

The backbone is made up of a series of round bones which are flat on top and bottom. Layers of cartilage and groups of ligaments and muscles connect the bones and the spinal cord is found in the back center of these round bones. The cord carries all the nerves from the nerve system of the body.

One of five things may happen when the back is injured.

A bruise or sprain may be present.

A bony process that comes off the vertebrae may be broken.

One of the round bodies of the vertebrae may be broken.

There may be a displacement between the vertebrae crushing the spinal cord.

Last, the spinal cord may be severed by being pinched or mashed by a break of one of the round bodies.

Treat all back injuries as a fracture—lay them flat—on their backs—a folded coat or cushion underneath—treat shock—seek medical aid.

Article 16.

Fracture of the Spine

You can tell if there has been an injury to the back in an accident victim by the presence of pain in the region but you cannot tell if there has been a serious injury or fracture unless the spinal cord that carries the nerves has been injured. A doctor often is unable to determine whether there is a fracture until an X-ray has been made. But when the cord has been crushed the patient will be unable to move his legs.

If the patient complains of pain in the back, keep him lying stretched out flat or better still, place him on his abdomen and chest and treat shock. If he is forced to sit up or is placed in an automobile one of the round bodies which may have been broken will slip backward and he will fold up like a jack-knife at the point the bone is broken, crushing the spinal cord.

Crushing the spinal cord is similar to mashing a banana without breaking the skin.

Let him lie, don't attempt to manhandle him. Wait for a stretcher to carry him lying flat—to a conveyance where he can remain lying flat during the trip to the hospital.

Remember, if a vertebra has been broken, which you don't know, and you move him causing a jack-knife injury, the patient is liable to be paralyzed for life. The broken bone in the back can heal but the crushed cord never heals.

Let him lie—treat shock.

Article 17.

Fracture of the Spine

The proper method to use in bringing the back-injured person into the hospital is to leave him lying flat until a stretcher or blanket can be obtained upon which he is to be rolled and lifted to the waiting vehicle—stretched out and with adequate support to the middle of the back. He must be stretched out flat in the ambulance or truck with a small pillow or pad under the small of the back.

To attempt to lift him by the shoulders and feet will be to invite jack knifing the spine which will crush the spinal cord. If he is lifted into a blanket, don't let the middle of the back sag as this is where support is most needed. It is better to have the head and feet extend over the ends of the stretcher, or support, than to chance the back being unsupported.

Remember these simple rules and help prevent disabilities.

Leave them where they lie—stretched out flat—treat shock.

Article 18.

Fracture of the Pelvis

In injury to the pelvis, shock is usually severe and is the first thing to be considered in treating the patient. He should be kept quiet, warm and still.

Strap the pelvis snugly with belts or a couple of shirt sleeves put together. Of course it will be impossible to splint this injury, but much comfort will be felt by the patient if the pelvis is supported by strapping.

Do not attempt to lift the patient as one of the bone ends might puncture a body organ such as the bladder, and involve more serious injury.

Pain will be severe unless shock is so great there is only numbness felt by the injured one. Do not sit him up, keep him flat, warm and quiet. Wait for the ambulance to come to him, and continue to treat shock.

Let him lie, warm and quiet and strapped about the pelvis snugly with belts. The State Highway Patrol should always be called to the scene of an accident.

Article 19.

Head Injuries

No matter how slight the outward appearance of the head injury may be, if unconsciousness occurs the brain is injured and extreme caution should be observed. Do not move the patient, let him lie and control shock.

Brain injuries are the result of concussion, contusion, or hemorrhage; when a person is knocked out, it is due to one of these causes, or a combination of two, or perhaps all three. There is no way to tell, a bad scalp wound may be superficial; a wound appearing slight may be serious, so play safe; treat them all as serious and keep the patient still.

Concussion is a shaking up of the brain, but it does not leave after-effects, while contusion is an actual bruising of the brain. Hemorrhage is due to the rupture of a blood vessel in the brain or in one of the brain coverings.

Even in the absence of delirium or extreme restlessness there may be internal hemorrhaging present which would not cause delirium until the pressure of bleeding reached a certain point.

To move them about frequently increases bleeding and causes unconsciousness, paralysis, and sometimes death.

Bleeding tends to clot itself as you have been told previously, so give it a chance to stop by keeping the patient still, quiet and warm.

If weakness shows itself in the face when the patient tries to smile or a leg or arm on one side is weak, it means contusion or hemorrhage, or both may be present. If the patient drifts in and out of consciousness, the situation is even graver, as internal hemorrhaging is present.

Let him lie, don't sit him up—treat shock.

Article 20.

Head Injuries—Continued

Treat all head injuries as serious.

If the pulse is slow, around 50 or 60 a minute, the brain is swollen from

the injury or internal bleeding is excessive, so be cautious. Keep him quiet, warm and still.

If breathing is difficult due to mucus in the throat, turn the face to one side with the head down hill so that it may drain from the mouth. This will prevent the injured dying from strangulation in their own secretions while they are unconscious and unable to cough up the mucus.

When there is bleeding from the nose or ears, the base of the brain has been fractured. There may be a fracture of the skull—with or without a scalp wound. Sometimes there is a crack on the opposite side from the blow due to transmitted force. The concussion or hemorrhage may also be on the side opposite the one receiving the blow. Where paralysis is present on one side of the body, the brain injury is on the opposite side. Paralysis may be total or partial, depending on the amount of the bleeding.

So do not move the patient or allow him to stand, sit or try to walk about; keep him flat, quiet—and, control shock.

If other wounds are present, follow previous instructions, but avoid all unnecessary handling.

Seek medical aid.

Article 21.

Chest Injuries

In chest injuries shock may be the most serious factor, so keep them flat, head down and feet up.

In event only a rib or two are broken, shock will not be so severe. But if shock is severe and breathing is shallow and fast—be careful.

If the pulse is extremely rapid, if the patient is clammy and pale and spits up blood, you may know he is injured internally. Perhaps the broken end of a rib has pierced the lung or several ribs have been mashed in and a section of the lung crushed. In this case a lot of blood may be spit up by the injured person.

The heart may be bruised in such an injury, or even ruptured, in which event he will bleed to death.

The important thing to do is to lay him down with sufficient cover to keep warm. Don't pile him into a car and rush in—keep him quiet, warm and let him lie until shock has been controlled and proper transportation secured—preferably an ambulance.

Article 22.

Abdominal Injuries

The abdomen is the largest cavity in the body. It lies between the chest and pelvis and is protected by short thick muscles and the backbone in back and by long thin muscles in front.

The lining of this cavity is like a sac, and contains all the body organs except the lungs and heart. The stomach and intestines are not anchored in this sac; therefore, in the event of a blow to the abdomen these organs, being free, can slide away from the impact. With the liver, spleen, pancreas, and kidneys it is a different story, for they are fixed to the back wall of this

cavity and can not escape the impact. As a result these organs may be torn or broken.

When this happens to a person the first thing to consider is shock.

Following this type of injury, internal bleeding will occur. The pain will be intense and the muscles of the abdomen will be held taut. To touch these areas or to move will increase pain.

If the kidney is torn the pain will be localized in the back.

The bladder, if very full at the time of the accident, may be ruptured, even though it is protected back of the front bones of the pelvis. If this happens the pain will be intense in the lower part of the abdomen.

Keep them flat, let them lie, and keep them warm.

Seek medical aid—transport carefully.

Article 23.

Abdominal Injuries

In answer to what you should do in case of abdominal injuries, remember, lay them flat, keep them still and warm, but do not give them a drink, as that may cause vomiting and increase hemorrhaging. Moving may cause more bleeding, too, so keep them quiet and still. Transport carefully—preferably by ambulance.

A torn internal organ will bleed the same as a wound on the surface, but remember that blood will clot if allowed the necessary time. If you let them lie and keep them still and warm until the pulse becomes slower, the blood will probably clot and the tear seal itself so that bleeding ceases.

Eighty per cent of the deaths of automobile accident victims that die en route to the hospital, or immediately upon reaching the hospital, could be prevented if the patient received proper first aid treatment and not too much manhandling and hurry.

Remember that shock is the first thing to treat. Keep them warm, still, quiet—let them lie, do not try to set them up.

Treat shock.

First aid is taught at Red Cross stations. Why not follow this up with a course in first aid?

BOOK REVIEWS

The Editors of THE SOUTHERN SURGEON *will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The Editors do not, however, agree to review all books that have been submitted without solicitation.*

THE TREATMENT OF BURNS. By HENRY N. HARKINS, M.S., M.D., Ph.D., F.A.C.S., Associate Surgeon, Henry Ford Hospital, Detroit; Formerly Instructor in Surgery, University of Chicago; John Simon Guggenheim Memorial Fellow in Surgery, 1938-1939. 457 pages, with 120 illustrations. Price, $6.50. Springfield, Illinois, and Baltimore, Maryland: Charles C Thomas, Publisher, 1942.

The title of this book does not make reference to its total content. The author, by virtue of opportunities afforded him through the John Simon Guggenheim Memorial Fellowship, has been able to make an exhaustive study of burns—experimentally, clinically, and through the medium of literature and contacts with authorities all over the world. The book is divided into two main parts: The Burn and Its Effects, and Treatment. The first considers histologic pathology, chemical changes, blood concentration, shock, the adrenals, fluid loss, toxins, infection, and complications. The second part covers general treatment and its relation to local treatment and special technics of the latter.

A smaller section considers burns with reference to regional anatomy and with respect to the physical agent. There is a small section on trauma due to freezing. The last section in the book is entitled Practical Outline of Burn Treatment.

Burns of the groin and flexor surfaces are more severe than burns in other regions, possibly because of the loose tissues in these areas. The greater severity of burns of the face may be attributed to the sensitivity of the trigeminal nerve, to the marked vascularity of this region, or even to the concomitant inhalation of fumes, vapors or flames.

Prognosis in burns is dependent upon the nature of the burning agent; the age, sex, occupation, and individual tolerance of the patient; the extent of body surface affected; the depth of the burn and its location; and the nature of complications.

Although burns from liquids are believed in some circles to be more severe than other type burns of similar extent, one must consider that there is less *apparent* damage with scalds.

Of medicolegal interest is the differentiation of antemortem from postmortem burns. This is done on the basis of the type of exudate in whatever blebs are present, the local reaction of the tissues to the thermal trauma, and the presence of soot in the bronchioles.

Some of the general pathologic changes described in human beings and in experimental animals have been minute capillary thrombi, particularly in the liver, spleen, and kidneys; petechial hemorrhages; pulmonary edema; uremic symptoms; embolism in the lungs; changes in the adrenals; gastroenteritis; cerebral edema; cardiac damage—as focal necrosis, calcification, cellular infiltration, and connective tissue proliferation; marked destruction of lymphoid tissue; polyserositis; and many stages of liver destruction. Of course, the author makes mention of many others.

Evidence of liver damage may be an increase in the icterus index, a decrease in the urobilin in the urine, or even frank jaundice. Late liver damage may be partially checked or even prevented by the use of intravenous glucose

and vitamin B-1. The rationale of this last procedure is the building up of the liver store of glycogen which is believed to help it over the stage of toxemia.

An anaphylactic element may be present in the secondary shock of burns, since there is noted an immediate eosinophilia, particularly in the cellular reaction of the lungs.

In many cases of severe burns, a decrease in the urinary output may be the first sign of impending toxemia. There is a decrease in the sedimentation rate during the first three days following a burn, after which there is a marked increase. This latter has been ascribed to the incipiency of infection. The former cannot be explained on the basis of hemoconcentration alone, strangely enough. The author says that changes in blood pressure, hemoconcentration, local fluid accumulation, decreased blood volume, and decreased cardiac output are some of the more important physiologic changes which take place as the sequelae of severe burns.

Present world conditions make the study of burns a most important aspect of preparation for the part which the medical profession is to take in its line of duty. This book, according to the author, is the latest thing on the matter, and it seems to be comprehensive.

There is a bibliography with 1320 references, supplemented by a five-page subject guide. There are historical sketches of past treatments of burns and biographies of famous physicians whose names appear most frequently in them. There is an index of subjects and an index of authors. In all, there are 457 valuable pages.

SKIN GRAFTING, *from a Personal and Experimental Viewpoint.* By EARL CALVIN PADGETT, M.D., F.A.C.S., Professor of Clinical Surgery, University of Kansas School of Medicine, Kansas City, Kansas. 149 pages, with 65 illustrations. Price, $4.50. Springfield, Illinois and Baltimore, Maryland: Charles C Thomas, Publisher, 1942.

Of course, to anyone with much experience in this phase of surgery, the book is largely a recapitulation of past theory and practice, but it is well organized and presents an authority's personal observations—which may be interesting and enlightening to specialist and general man alike.

The theoretical aspects of transplantation of tissues from their natural sites particularly struck the fancy of the reviewer, and some of the more interesting concepts, as brought out by the author, are reproduced. One might think of hemotransplantation much as one thinks of blood-matching. Indeed, it has been found that "takes" occur more readily when the donor's and recipient's bloods are found to be compatible. Ultimately, however, in most cases, there is eventually a destruction of the graft unless the relationship between donor and recipient be as close as that of identical twins.

Loeb, the great experimenter in genetics and parthenogenesis, advanced the theory of organismal differentials which is the basis for the reaction between host and donor tissues. The failure of a permanent "take" in skin-grafts other than auto-transplantation is not explained as a sensitization phenomenon, but as a local reaction of host tissues to "toxins"—or to substances which have too great an organismal differential with respect to the host tissues. The less the organismal differential—or the closer the kin—by heredity, blood-type, or phylogenetically, the more success, although transient, is to be expected. The author concludes that "homotransplantation of skin may be relegated to the realms of medical mythology."

Of practical importance in skin-grafting technic has been the problem of getting a large sheet of uniform thickness. The author describes the man-

ner in which this difficulty is now overcome—by the use of the dermatome. With this device, areas of skin up to 32 square inches of uniform thickness (down to .008 inches) may be transplanted with good results in both donor and recipient areas. The dermatome has the advantage of being a mechanically accurate instrument, removing the element of questionable art.

There are many "before and after" pictures, abundant charts, technics, indications and contraindications, and all the other things which go to make up a scientific presentation of an important subject.

SYNOPSIS OF GENITOURINARY DISEASES. By AUSTIN I. DODSON, M.D., F.A.C.S., Professor of Genitourinary Surgery, Medical College of Virginia; Genitourinary Surgeon to the Hospital Division, Medical College of Virginia; Genitourinary Surgeon to Crippled Children's Hospital; Urologist to St. Elizabeth's Hospital; Urologist to St. Luke's Hospital and McGuire Clinic, Richmond, Virginia. Third Edition. 302 pages with 112 illustrations. Price, $3. St. Louis: The C. V. Mosby Company, 1941.

In the preparation of this handbook of genitourinary diseases Dr. Dodson has written clearly and succinctly. Needless to say he also writes with authority: he presents a consensus of the best urologic opinion not as of 1934, but of 1941. He also has an excellent sense of perspective: one could never guess from the emphasis in his book what are his particular hobbies in the field of urology. This edition might have been more carefully edited: for example, in 1941 it is hardly appropriate to refer to the "recent introduction of sulfanilamide." The third edition in seven years is adequate evidence of its worth.

Dr. Dodson has collected excellent illustrations (with credit to those who first presented them of course) and had them well redrawn for the sake of uniformity.

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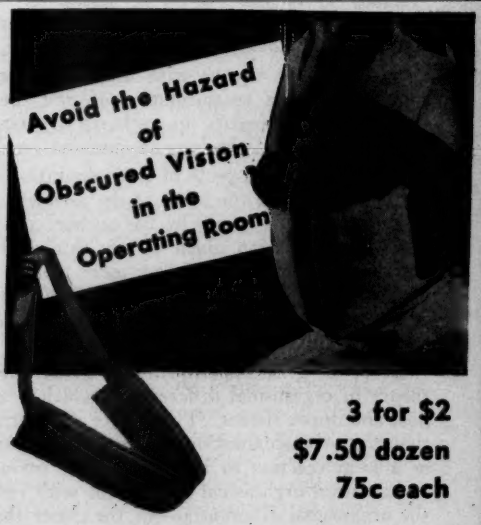

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